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P R E F A C E

THIS report, with the exception of Dr. Stockton's paper on "The Spinal Form of Arthritis Deformans," consists of a collection of papers which have already been published in various medical journals.

The expenses of publication have been defrayed by the Permanent Faculty of the Medical Department.

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THE SPINAL FORM OF
ARTHRITIS DEFORMANS

CHARLES G. STOCKTON, M. D.,

with table prepared by

CHARLES A. BENTZ, M. D.

THE SPINAL FORM OF ARTHRITIS DEFORMANS.

BY CHARLES G. STOCKTON, M. D.

The skeleton first to be described in this paper is believed to be unique; it is that of a so-called ossified man. It was exhibited May 1, 1901, at a session of the Association of American Physicians at the request of Dr. William Osler, on which occasion it attracted general attention, and led to considerable discussion. It belongs to the museum of the Medical Department of the University of Buffalo, to which it was presented by Dr. Roswell Park; credit is also due to Dr. Arthur G. Bennett for the forethought which led to its preservation.*

I had the opportunity of seeing during life the man from whom the skeleton came, and of making some clinical observations upon the case. Born in England of mixed French and English parentage, he was at the time of his death forty-four years old. He was received as a patient in the Erie County Alms House in 1878, at which time he had lived eleven years in the United States. He died after having been in the institution fifteen years. By occupation he was a stone mason, was of intemperate habits, and sought relief because of disability, the result of chronic arthritis which began some five years before as the continuation of a gonorrhreal arthritis.†

This joint affection was progressive after his entrance, and for about three years before his death he was unable to move any of his joints. It was necessary to extract his incisor teeth

*A photograph of it appears in Dr. Park's Treatise on Surgery, and in the Transactions of the Association of American Physicians for 1901.

† During this year there has been under my observation, in the wards of the Buffalo General Hospital, a man twenty-six years old, who presents a condition of his articulations which seems to bear a most interesting relation to the skeleton under discussion. The patient suffered from gonorrhœa two years ago, a few weeks after which there developed an arthritis in all four extremities, and eventually an involvement of all the articulations of the body, and especially of the spine and jaw. This arthritis has been progressive, and for some months the man has been absolutely helpless. He has assumed the same posture as that shown in the skeleton above described. He has atrophy of the soft parts, neuralgic pains, and in all respects his history conforms closely to that of the man from which the skeleton was taken. His clinical picture is now the counterpart of that which the other presented at the same period in his history. I believe that this case, if he survives long enough, will become another instance of an ossified man.

so that he could be fed. There was marked constipation. He complained of much pain, and was most relieved by taking acetanalid in doses of ten grains combined with whiskey. The deeply pigmented skin was stretched tightly over a most emaciated and motionless figure. Toward the end, there was advanced muscular atrophy, especially in the extremities. He maintained the dorsal decubitus, propped up, until ultimately he became fixed in the peculiar posture seen in the skeleton. (Figure 1.) Continued pressure led to an extensive bed sore in the region of the sacrum, with erosion and atrophy of the sacral bones. (Figure 4.) At the time of his death it was supposed that there was universal bony ankylosis, but after the preparation of the skeleton it was discovered that in a few joints ankylosis was not bony. (Figure 5.) There is bony union, by osteophytic outgrowths, of the spine, the skull, the pelvis and the femurs, and right jaw, as though the bones had been welded together. (Figures 1, 2, 4 and 7.)

Attention is called to the most painstaking and critical analysis of the condition of the various articulations of the skeleton prepared by Dr. Charles A. Bentz, which is appended. There is absence of any sign of eburnation or absorption of bone at articulations, except at the sacrum. Here, as a result of the ulceration of the bed-sore and of pressure, there is erosion and partial absorption of the sacral bones. It is true that in some places there are examples of absorption of bone unusual in character, but in no way related to the articulations. This process of absorption renders the specimen extraordinary if not unique. It is seen in the unusual depths of the grooves of the bones along which passed the tendons of muscles. This is best illustrated by the photograph of the pelvis (Figure 4) in which the groove of the psoas muscles on either side is greatly exaggerated, and passes downwards across the ankylosed hip joint, cutting deeply into the head of the femur. The same peculiarity will be observed at the lower extremity of the radius and ulna on either side relating to both the extensor and flexor tendons (Figure 5); also in the bicipital groove, which extends more than three inches along the shaft

of the humerus; also in the grooves for both flexor and extensor tendons of the tibia and fibula. In fact the tendency toward the deepening of the natural grooves, or of the forming of grooves where none normally occur is seen in practically all regions where the pressure from tendons might be exercised. The development of osteophytes particularly occurs in relation to the articulations, the bony formation being at the expense of the cartilage. In numerous places, however, the cartilages not connected with articulations have become ossified (Figure 3), but no such developments are to be found apart from the regions where cartilage is normal.

An interesting fact is the absence of very firm ankylosis in those articulations having little or no motion, as for instance, those of the manubrium with the gladiolus, the clavicles with the sternum and the bones of the face except the inferior maxillary. (Figure 2.) On the other hand, most of the articulations that undergo strain, and are subject to motion, are strongly knit in bone. This is less evident as the extremities are approached; the process apparently beginning in the spine (Figure 7), and progressing towards the periphery.

Considerable interest has been excited as to the precise nature of these cases of spinal arthritis. In the prevailing opinion they are to be classed as types or varieties of arthritis deformans, and not as a special disease. There is one type described by Bechterew, in which the joints of the extremities remain uninvolved while the spine and thorax become rigid from ankylosis; there is atrophy of muscles, and neuralgic pains are prominent. Another type, described both by Strümpell and Marie, shows the same ankylosis of the vertebræ, but in this form the hips and shoulders, and also the joints of the extremities, take part in the arthritis and to some extent in the ankylosis. It is evident that this skeleton belongs to the latter type. If we admit that these forms of spondylitis are merely expressions of arthritis deformans, it becomes important to find the proper limitations in the use of this term. Aside from the spinal cases, there remain several varieties which are generally classified as arthritis deformans.

First, a type usually appearing in females in early or middle life, frequently implicating the small joints of the hands and feet, but also involving the large joints, and, to some extent, those of the spinal and temporo-maxillary articulations. In the extremities the affected joints take on a spindle shaped swelling, and effusion occurs in the synovial cavities, and into the neighboring bursæ. There is marked muscular atrophy, and sometimes considerable pain, anemia and slight temperature. The disease usually follows debilitating and depressing influences, is slow in its progress, and may be arrested during the early part of the attack, or on the other hand may go on to hopeless crippling.

The second type is also more commonly seen in women, but usually later in life. There is a certain symmetry in the order of joint involvement. The terminal joints of the fingers are more often attacked than in the previous form of the disease. There also is decided muscular atrophy, and occasionally, although not invariably, severe pain. The enlargement of joints is sometimes conspicuous, and apparently depends upon bony outgrowth rather than upon the swelling in the soft parts about the joints. These nodular prominences are confined to the immediate neighborhood of the articulations, and the fusiform swelling, seen in the preceding type, does not appear. When the joints are moved, a sensation of bony crepitus is distinctly felt. There is often eburnation of the bone endings, and at times marked atrophy, occasionally leading to dislocation of a joint.

There is a third and less common form met with in children, which closely resembles the type first described. The distribution of the lesions is often less symmetrical than in the second type, and the fingers and toes are commonly spared, while the joints of the wrists, ankles and knees are attacked. In this type of the affection, the cartilages largely escape disease, and there is marked hypertrophy and fringing of the synovial tissues.

It is difficult to believe that these various manifestations, including those of spondylitis, are merely expressions or types

of a common disease, but as yet there is no satisfactory evidence to fully justify a contrary position. It is interesting to remember that our case was the continuation of a gonorrhœal arthritis. In an able discussion on this subject before the British Medical Association (*British Medical Journal*, October 12, 1901), Dr. Ed. John Cave made this sapient observation: "It is well recognized that various anatomical forms may result from the same infective agent, and conversely, that various infective agents may produce the same anatomical forms." It is probable that some such, though unexpressed, belief as to the nature of the disease led to the use of the old name of rheumatic gout. It must be said that as yet there has been brought forward no single factor which can be admitted as the special cause of arthritis deformans.

The museum also possesses a second specimen which is of unknown origin, and of which there is no history. It consists of seventeen vertebræ, including the last cervical, twelve dorsal, and the upper four lumbar. This spine is remarkable in the fact that it shows in many points osteophytic growths at the expense of cartilage. In several of the dorsal vertebræ this process has resulted in complete bony union. The osteophytes in this specimen have especially grown from the rim of the articulating surfaces of the bodies of the vertebræ, so that a cup-like receptacle is formed in which sets the adjoining bone. This "nesting" or telescoping effect may be seen in Figure 8. A fact still more remarkable than the osteophytic development is the bony atrophy which is everywhere conspicuous. Little compact tissue can be found in the bodies of the vertebræ. They are cancellous, honeycombed and worm-eaten in appearance, suggesting Paget's disease. The processes show the same change, but not in the same degree. We have in this specimen, therefore, the illustration of the disappearance of normal bone and the development of abnormal bone apparently going on at the same time, the latter process being sufficiently extensive to weld the second, third and fourth dorsal vertebral bodies into one.

FIGURE I.

Skeleton of the case of Arthritis Deformans.
Spinal Form.

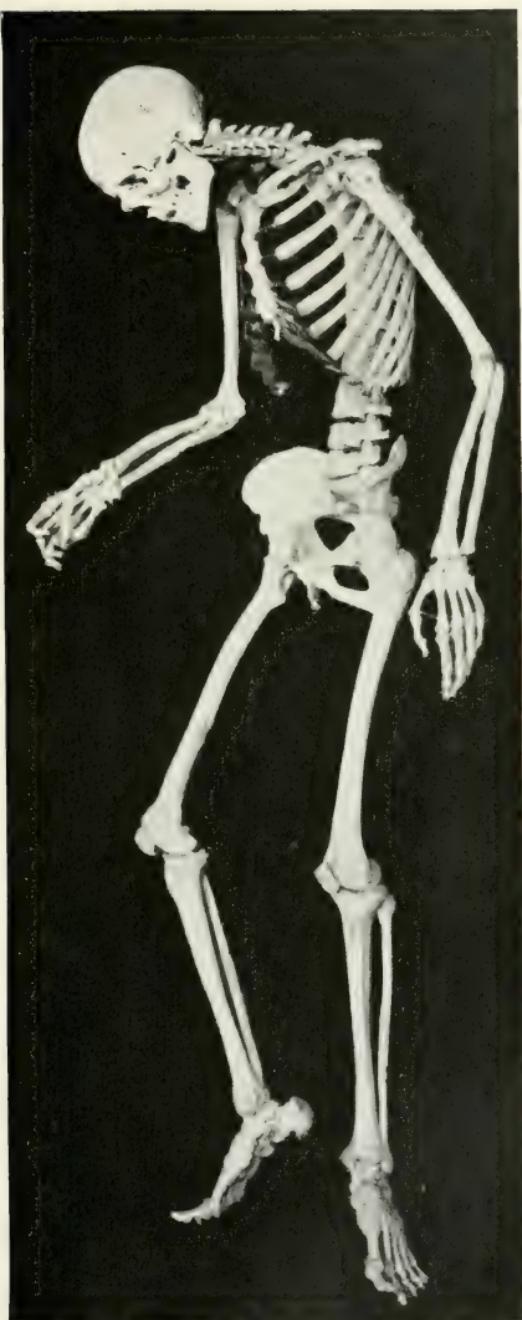


FIGURE 1

FIGURE 2.

Right temporo-maxillary articulation, showing
bony ankylosis.

FIGURE 3.

Sternum and costal cartilages of skeleton
shown in Figure 1.

FIGURE 4.

Pelvis of skeleton shown in Figure 1, showing necrosis of
sacrum, grooves of psoas muscles, and bony
union of femurs with pelvis.



FIGURE 2



FIGURE 3

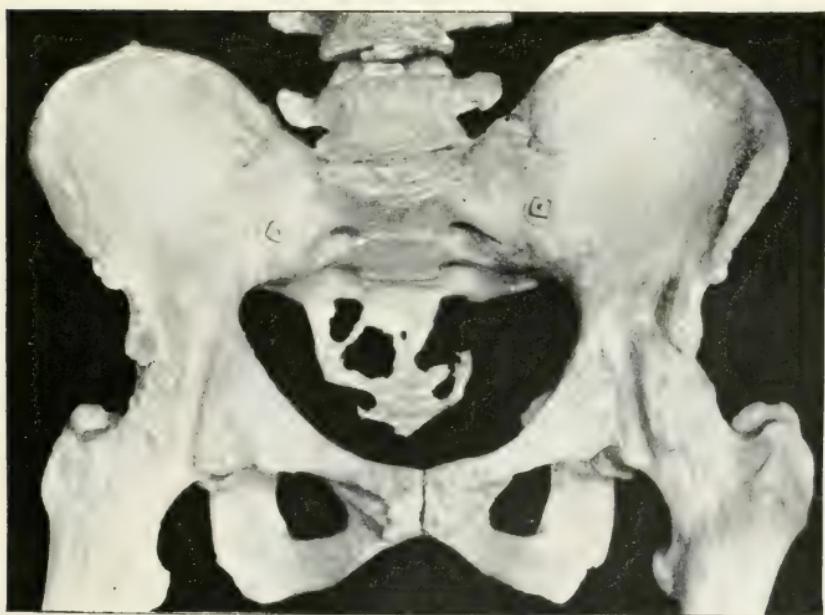


FIGURE 4

FIGURES 5 AND 6.

Hand and foot of skeleton shown
in Figure 1.



FIGURE 5



FIGURE 6

FIGURE 7.

Spine of skeleton shown in Figure 1.

FIGURE 8.

Spine of case 2, mentioned in text, showing
telescoping of vertebræ.

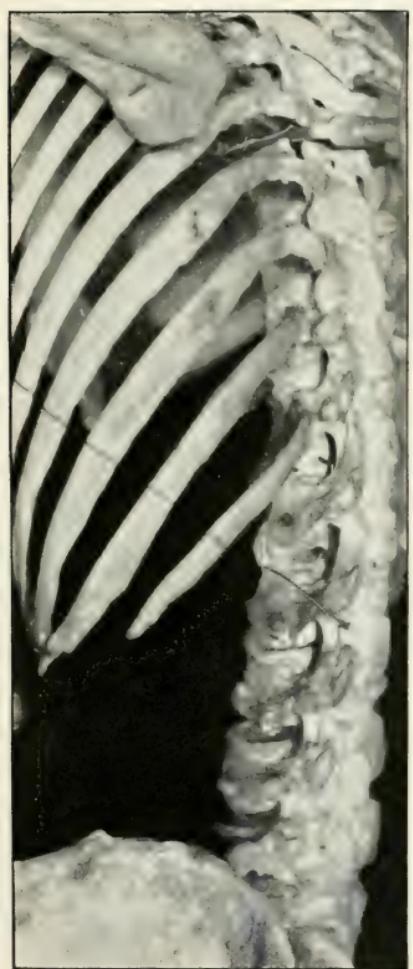


FIGURE 7

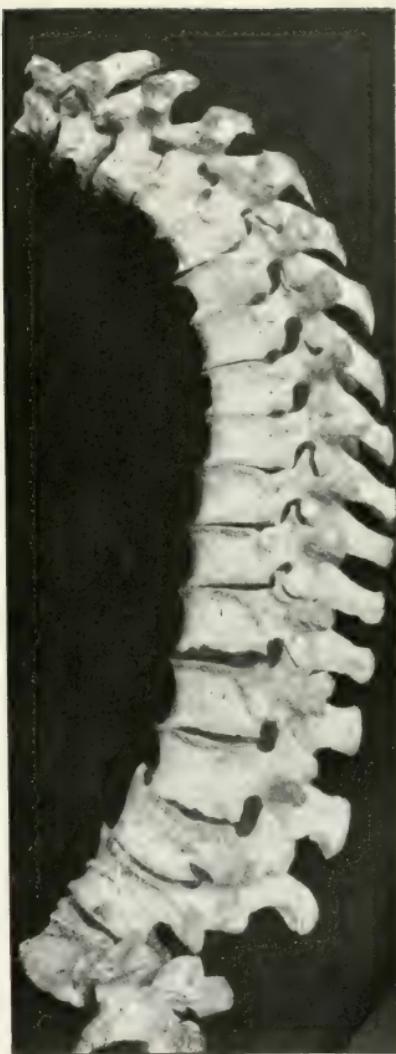


FIGURE 8

	ARTICULATIONS.		Bony Ankylosis or No Ankylosis.	OSTEOPHYES.
HEAD				
Jaw	Inferior Maxillary (right side)	Temporal	Bony Ankylosis	
	Inferior Maxillary (left side)	"	No	"
Sutures	Frontal	Parietals	"	"
	"	Nasals	"	"
	Parietals	Parietal	Bony	"
	"	Temporals	No	"
	"	Occipital	Bony	"
	Occipital	Temporals	No	"
	Temporals	Sphenoid	"	"
Right stylo— maxillary ligament			Bony	"
Left stylo— maxillary ligament			No	"
VERTEBRAL COLUMN				
Cervical ver- tebræ	Occipital Atlas	Atlas Axis	Bony	"
Disk between	2d Vertebra	3d Vertebra	"	"
	3d "	4th "	"	"
	4th "	5th "	"	"
	5th "	6th "	"	"
	6th "	7th "	"	"
Ligaments between	1st "	2d "	"	"
Interspin- ous ligaments between	2d "	3d "	No	"
	3d "	4th "	Bony	"
	4th "	5th "	No	"
	5th "	6th "	"	"
	6th "	7th "	Bony	"
Articular facets on trans- verse processes	1st "	2d "	"	"
	2d "	3d "	"	"
	3d "	4th "	"	"
	4th "	5th "	"	"
	5th "	6th "	"	"
	6th "	7th "	"	"
DORSAL VERTEBRAE				
Disk between	7th Cervical Vertebra 1st Dorsal	1st Dorsal Vertebra 2d "	"	"

DORSAL

VERTEBRÆ

—Continued

ARTICULATIONS.

Bony Ankylosis
or
No Ankylosis.

OSTEOPHYTES.

		ARTICULATIONS.		Bony Ankylosis		OSTEOPHYTES.	
DORSAL		2d Dorsal Vertebra	3d Dorsal Vertebra	Bony Ankylosis			
Disk between	3d	"	4th	"	"	"	"
	4th	"	5th	"	"	"	"
	5th	"	6th	"	"	"	"
	6th	"	7th	"	"	"	"
	7th	"	8th	"	"	"	"
	8th	"	9th	"	"	"	"
	9th	"	10th	"	"	"	"
	10th	"	11th	"	"	"	"
	11th	"	12th	"	"	"	"
Articular facets on transverse processes	7th Cervical	"	1st	"	"	"	"
	1st Dorsal	"	2d	"	"	"	"
	2d	"	3d	"	"	"	"
	3d	"	4th	"	"	"	"
	4th	"	5th	"	"	"	"
	5th	"	6th	"	"	"	"
	6th	"	7th	"	"	"	"
	7th	"	8th	"	"	"	"
	8th	"	9th	"	"	"	"
	9th	"	10th	"	"	"	"
	10th	"	11th	"	"	"	"
	11th	"	12th	"	"	"	"
Interspinous ligaments between	7th Cervical	"	1st	"	"	"	(Incomplete)
	1st Dorsal	"	2d	"	"	"	"
	2d	"	3d	"	No	"	"
	3d	"	4th	"	"	"	"
	4th	"	5th	"	"	"	"
	5th	"	6th	"	"	"	"
	6th	"	7th	"	"	"	"
	7th	"	8th	"	Bony	"	"
	8th	"	9th	"	"	"	"
	9th	"	10th	"	"	"	"
	10th	"	11th	"	"	"	"
	11th	"	12th	"	"	"	"
LUMBAR VERTEBRÆ							
Disk between	12th	"	1st Lumbar	"	"	"	"
	1st Lumbar	"	2d	"	"	"	"
	2d	"	3d	"	No	"	"
	3d	"	4th	"	Bony	"	"
	4th	"	5th	"	"	"	"
Articular facets on transverse processes	12th Dorsal	"	1st	"	"	"	"
	1st Lumbar	"	2d	"	"	"	"
	2d	"	3d	"	"	"	"
	3d	"	4th	"	"	"	"
	4th	"	5th	"	"	"	"

		ARTICULATIONS.		Bony Ankylosis or No Ankylosis.	OSTROPHITES.
LUMBAR VERTEBRÆ —Continued					
Interspinous ligaments between	12th Dorsal Vertebra 1st Lumbar 2d 3d 4th	“ “ “ “ “	1st Lumbar Vertebra 2d “ “ “ “ “	Bony Ankylosis “ “ “ “ “	
SACRAL VERTEBRÆ	5th 1st Sacral 2d 3d 4th	“ “ “ “ “	1st Sacral 2d “ “ “ “ “	“ “ “ “ “	
RIBS	Sacrum “		Ossa innominata Coccyx (1st segment)	“ “	
Vertebral extremity	Head of 1st rib on Body of 1st Dorsal right and left side Neck and tubercle of Transverse processes 1st rib on right and of 1st Dorsal left side Head of 2d rib on right Bodies of 1st and 2d and left side Neck and tubercle of Transverse processes 2d rib on right and of 2d Dorsal left side Head of 3d rib on right Bodies of 2d and 3d and left side Neck and tubercle of Transverse processes 3d rib on right and of 3d Dorsal left side Head of 4th rib on Bodies of 3d and 4th right and left side Neck and tubercle of Transverse processes 4th rib on right and of 4th Dorsal left side Head of 5th rib on Bodies of 4th and 5th right and left side Neck and tubercle of Transverse processes 5th rib on right and of 5th Dorsal left side Head of 6th rib on Bodies of 5th and 6th right and left side Neck and tubercle of Transverse processes 6th rib on right and of 6th Dorsal left side Head of 7th rib on Bodies of 6th and 7th right and left side		Dorsal Vertebrae	“ “	
				“ “	
				“ “	
				“ “	
				“ “	
				“ “	
				“ “	
				“ “	
				“ “	
			Dorsal Vertebrae	“ “	

RIBS

—Continued

	ARTICULATIONS.	Bony Ankylosis or No Ankylosis.	OSTEOPHYTES.
RIBS			
	Neck and tubercle of Transverse processes 7th rib on right and of 7th Dorsal left side	Bony Ankylosis	
	Head of 8th rib on Bodies of 7th and 8th right and left side | Dorsal Vertebrae	" "	
	Neck and tubercle of Transverse processes 8th rib on right and of 8th Dorsal left side	" "	
	Head of 9th rib on Bodies of 8th and 9th right and left side | Dorsal Vertebrae	" "	
	Neck and tubercle of Transverse processes 9th rib on right and of 8th Dorsal left side	" "	
	Head of 10th rib on Body of 10th Dorsal right and left side | Vertebra	" "	
Vertebral extremity	Neck and tubercle of Transverse processes 10th rib on right and of 10th Dorsal left side	" "	
	Head of 11th rib on Body of 11th Dorsal right and left side | Vertebra	" "	
	Neck and tubercle of Transverse processes 11th rib on right and of 11th Dorsal left side.	" "	
	Head of 12th rib on Body of 12th Dorsal right and left side | Vertebra	" "	
	Neck and tubercle of Transverse processes 12th rib on right and of 12th Dorsal left side	" "	Osteophytes about chon- dro-sternal ar- ticulations of the 4th, 5th, 6th ribs on the left side; also between the cartilages of the 5th and 6th ribs.
			Osteophytes about chon- dro-sternal ar- ticulations of the 3d, 4th, 5th ribs on the right side; also between the cartilages of the 5th and 6th ribs.

		ARTICULATIONS.	Bony Ankylosis or No Ankylosis.	OSTEOPHYTEs.
RIBS <i>—Continued</i>				
Sternal extremity			Ossification of Cartilage connecting 9th, 10th, 11th ribs on left side Ossification of Cartilage connecting 9th and 10th rib on right side	Osteophytes on 9th, 10th, 11th ribs on left side
STERNUM	Segments	to each other	Bony Ankylosis	
Ligaments	Sternum	Clavicles	" "	
	Coraco-Clavicular	1st Rib on right and left side	" "	
PELVIS	Ossa innominata	Sacrum	" "	
	"	Femurs	" "	
	Right Ossa innominatum	Left Ossa innominatum	" "	
SCAPULA	Clavicles	Sternum	" "	
	"	Scapulae	" "	
	Right and left Humerus	Scapulae	Transverse ligaments of both Scapulae ossified No Ankylosis	Osteophytes about heads of humeri and glenoid cavities of Scapulae
	Right and left Humerus	Radii	" "	Osteophytes surround heads of Radii, deepening Articular Surfaces
Upper extremity	Right and left Humerus	Ulnæ	" "	Osteophytes surround heads of Ulnæ, deepening Articular Surfaces
	Wrist Bones	Radius and Ulna on right and left side	" "	Small Osteophytes on Wrist Bones
	" "	Metacarpus	" "	Small Osteophytes on Bases and Heads of Metacarpus

SCAPULA
—Continued

	ARTICULATIONS.	Bony Ankylosis or No Ankylosis.	OSTEOPHYES.
	Right and left Femur Ossa innominata	Bony Ankylosis	Large Osteophytes on Great Trochanters
	“ “ “ Patella and Tibiae	No “	Osteophytes on Lesser Trochanters
	“ “ “ Tibiae	No “	Small Osteophytes on Patellæ, Tibia and Femurs
Lower extremity	Right and left Fibula Tibiae (superior)	Bony “	
	Right and left Fibula “ (inferior)	No “	Osteophytes
	Right and left Astragulus Tibia and Fibula	“ “	Osteophytes
	Right and left Tarsus to each other	Bony “	
	Right and left Metatarsus Tarsus	“ “	
	Right and left Metatarsus to each other	“ “	
	Sesamoids (right and left sides) Metatarsus and Phalanges	“ “	

— N O T E . —

Right and left Tibia, deepening of grooves for tendons of Flexor longus digitorum and Tibialis posticus muscles.

Right and left Astragulus, deepening of grooves for tendon of Flexor longus pollicis muscle.

Right and left Humerus, deepening of Bicipital groove.

“ “ “ Ulna, “ “ groove for tendon of Extensor carpi ulnaris muscle.
“ “ “ Ilium, “ “ Ileo-pectineal groove.

Right Radius, deepening of grooves for tendon of { Extensor carpi radialis longior muscle.
“ “ “ brevior “
“ “ secundi inter nodii pollicis muscle.
“ “ indicis muscle.
“ “ digitorum communis muscle.
“ “ minimi digiti muscle.

Left Radius, deepening of grooves for tendon of { carpi radialis longior muscle.
“ “ “ brevior “

Lower part of Sacrum necrosed.

A CASE OF
LYMPHATIC LEUKÆMIA

APPARENTLY DEVELOPING OUT OF HODGKIN'S DISEASE,
ACCOMPANIED BY LEUKÆMIC LESIONS AND PIG-
MENTATION OF THE SKIN, CULMINATING
IN STREPTOCOCCUS INFECTION.

By GROVER WILLIAM WENDE, M. D.,
Clinical Professor of Dermatology, University of Buffalo.

A CASE OF LYMPHATIC LEUKÆMIA, APPARENTLY DEVELOPING OUT OF HODGKIN'S DISEASE, ACCCOMPANIED BY LEUKÆMIC LESIONS AND PIGMENTATION OF THE SKIN, CULMINATING IN STREPTOCOCCUS INFECTION.

BY GROVER WILLIAM WENDE, M.D.,
CLINICAL PROFESSOR OF DERMATOLOGY, UNIVERSITY OF BUFFALO.

(*From the Pathological Laboratory of the University of Buffalo.*)

SUMMARY OF CHIEF POINTS. *Hodgkin's disease, first shown by physical and blood examinations; lymphomatous in the skin, the first evidence of the disease developing where lymphoid tissue does not normally exist; subcutaneous and internal hemorrhages; spontaneous increase and reduction of tumors, characteristic of Hodgkin's disease; suddenly developing clinical and blood changes, showing transition from pseudoleukæmia into true lymphatic leukæmia; terminal tonsillar infection, resulting in general sepsis, with disappearance of blood picture of lymphatic leukæmia; subsidence of lymph nodes and spleen during infection.* **Personal History.** The patient, J. B., aged twenty-six years, first seen on April 26, 1900. His father died at the age of fifty-eight, presumably of some malignant disease of the bladder, and his mother at the age of forty-eight of inflammation of the bowels. His four brothers and one sister survive him, and have always had excellent health. To his knowledge none of his relatives, near or remote, ever suffered from his particular complaint or from any cutaneous affections. His habits were never vicious, he was never affected by syphilis.

Previous History. No assignable cause for patient's condition. It began with a slight induration of the epidermis and its underlying structure over the left temple, midway between the eyebrows and the margin of the scalp, first accidentally observed by the patient December 1, 1899, five months before he came under my notice. At first this increased very slowly, afterward more rapidly. For two months it was confined to the initiatory seat, during which period it attained the size of a twenty-five-cent piece. The patient then consulted a physician, who pronounced the lesion syphilitic gumma, and prescribed accordingly; as, however, under this treatment, there was no improvement, electrolysis was resorted to, which only served to stimulate the growth. A circumscribed hardness now became apparent in the centre of the cheek on the same side, though deeper in the cutis, and without change of coloring in the integument, the parts losing their suppleness. The patient experienced a hide-bound sensation whenever the jaw was moved. This manifestation, beginning on the left side, was irregular in outline, with a mean diameter of about five centimetres. The lymphatic nodes were enlarged from the moment of its inception, first in front of the ear, and subsequently involving the post-auricular, which became intensely painful. Later the inferior maxillary, and finally the cervi-

cal were affected, the latter attaining a considerable size. The accompanying pain and soreness were of short duration.

On February 20th a number of superficial, irregular, yellowish-gray spots were detected over the region of the sternum, while at the same time a slight infiltration manifested itself in close proximity to the left nipple, which increased with amazing rapidity. Other areas appeared correspondingly distributed over each side of the chest and back. These discolorations were of varying sizes and shapes, but their borders were well defined. As a sequence of this general dissemination, there ensued an enlargement of the lymphatic glands of the axillæ, which were more or less tender upon palpation. Apart from the slight tenderness of the glands, the patient suffered no inconvenience. Appetite good, habitually slept well, and continued to apply himself to heavy manual labor.

Examination of the Patient. Upon his arrival at Buffalo he was examined by Dr. Charles G. Stockton, who pronounced his organs healthy. No enlargement of the spleen discoverable. The examination of the blood, which was made by Dr. Albert E. Woehnert, showed at this stage no marked alterations, being as follows:

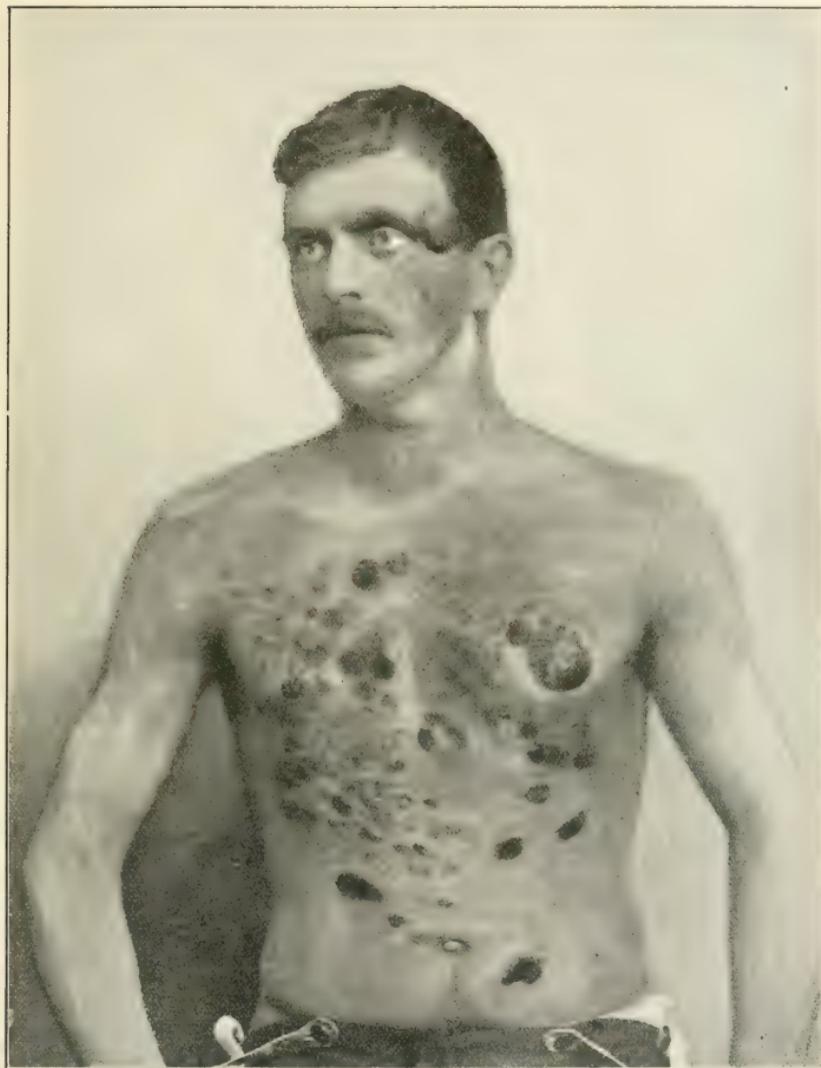
Erythrocytes . . . . .	. . . . .	5,128,000
Leucocytes . . . . .	. . . . .	4,000
Hæmoglobin . . . . .	. . . . .	88 per ct.
Lymphocytes (small) . . . . .	. . . . .	27 "
Lymphocytes (large and transitional) . . . . .	. . . . .	4 "
Polymorphonuclear neutrophiles . . . . .	. . . . .	68 "
Eosinophiles . . . . .	. . . . .	1 "

In counting the leucocytes, microcytes and microblasts were occasionally discovered. The red corpuscles were apparently somewhat irregular and pale. The urine had an acid reaction; specific gravity 1020; urea and uric acid slightly augmented; sugar and albumin absent; no casts or leucocytes, and but few crystals of uric acid.

The illustration of the case here presented was taken but a few days prior to the clinical record. It fairly demonstrates the topography of the multiple formations. The general tint of the skin was ruddy, as though sun-burned, while the areas upon the chest were as brown as burnt sienna—faithfully reproduced by the artist. The initial lesion, situated on the left side of the face, occupying the upper part of the temporal, the lower part of the frontal, and the exterior half of the supraorbital regions, formed an oval protuberance, with its long diameter extending from a point beneath the eyebrow to a point beyond the hairy portion of the scalp, where the individual hairs were raised like the spines of a porcupine. Its greatest length was nine and its greatest width ten centimetres. It was non-adherent beneath, sliding readily with the skin; the border was well defined and its dusky hue was without transition or the slightest erythematous tint, which was in keen contrast with the normal epidermis. The whole growth was hard and elevated above the contiguous skin. The entire surface was not only distinguished by its cyanotic tinge, but by numerous vibices, some in streaks, others cruciform. In the profile of the right eyebrow were two definite nodules, about the size of a pea, freely movable and in keeping with the normal color of the skin.

The centre of the left cheek bore a deep-seated infiltration of three and one-half to four centimetres in diameter, presenting an unaltered hue, except at the centre, which bore a tawny shade. The face lesions

were four in number ; the scalp was in nowise involved. Seated upon the body over the sternum were two lesions, each measuring ten to twelve millimetres. The infiltration of the upper one was invariably thin and



invested with a yellow pigmentation. In the lower one the infiltration was more pronounced and its circumference more definite ; it presented a bluish hue and showed a number of minute red spots, more or less irregular in contour. In the left inframammary region, approaching

the mesial line, were two spots about the size of a filbert, covered with normal skin, and deeply seated. On the left breast a large patch had formed around the nipple, similar to that situated on the temple. The areola of the nipple had disappeared. The surface of this patch was greatly elevated, and was oval in outline, with a long diameter of ten centimetres, quite hard, easily displaced, and more or less reticulated except at the centre and lower edge, which were shrouded with vibices. Situated on the lower portion of the abdomen were seven distinct and deeply-seated nodules, varying in size from a pea to a hickory-nut. In four the skin color was unaltered. The largest, and the one first developed, was of a cyanotic character, covered with a brown pigmentation. The peculiar features of all the lesions are not visible in the photographic reproduction, owing to the fact that they were so deeply embedded, without apparent change in the epidermis. The whole chest and back were mottled, showing numerous, well-defined pigmentary stains, and variegated blotches of different shapes and sizes. There must have been forty or more upon the anterior surface of the trunk, and nearly as many upon the posterior. These differed in size from a pea to a twenty-five-cent piece, and in some localities coalesced. They usually presented a circular form. This was especially true of the large ones—the smaller were frequently misshapen, sometimes grotesque. The prevailing color was a chocolate yellow. Barring the discolorations, the epidermis was seemingly normal. There was a decided hypertrophy of all the prominent superficial glands. The first to show any appreciable increase were two anterior to the left ear, just above the parotid. The post-auricular of the left side was the size of a hazelnut, and very sensitive. The post-cervical soon assumed the dimensions of a black walnut, but was not specially sensitive. The entire cervical group and the submaxillary glands were so enlarged as to be palpable. The glands of the trunk, with the exception of the epitrochlear and inguinal, were more or less involved and possessed uniform sensitiveness. The left axillary was the largest, the size of a walnut. On the whole, this hypertrophy of adenoid tissue was greater about the head and neck than upon the trunk, and less upon the lower extremity. The magnitude of the glands of the right side was not more than one-half that of those on the left side. There was no evidence of adhesions, the glands being readily separable. As a rule, the smaller were much harder than the larger ones. This briefly describes the condition of the patient when first seen.

Clinical History. Three days later there was a marked change in the primary lesion, the dimensions having increased four millimetres. This rapidity in the development seemed to demand its immediate removal, especially as its exact nature was not known. The operation was performed on the following day under cocaine infiltration, by making an incision around the growth. The edges were brought together by sutures, the wound healing quickly and bearing a fair linear cicatrix. The material of this growth, together with that of growths on the other portions of the body, was used for microscopical examination, to be described later. It will be sufficient at present to say that the growth was of a lymphomatous character. The patient was afterward placed under the hypodermic administration of arsenic. The subcutaneous injections began with six drops of Fowler's solution, increased two drops weekly, daily administered, and within three weeks all the mani-

festations showed improvement. New lesions ceased to form, the old ones manifested less infiltration, and all assumed a similar discoloration, which in the course of four weeks changed to a dark brown, and finally began to be absorbed at the periphery of the various smaller lesions. At the end of six weeks the larger infiltrated patches had practically cleared up, and the tumors disappeared, as well as the enlarged blood-vessels and cyanotic tinge. The skin resumed its natural aspect, except in the matter of pigmentation. During this period the improvement was progressive, but on June 4th there was an unexpected return of the difficulty, the glands taking on their former proportions. For the abruptness of this return there was no assignable cause. The new condition was, however, brief, for, after the lapse of thirty-six hours, the tenderness subsided and the hypertrophy of the glands gradually began to decrease. The general condition of the patient during the paroxysm was good; his appetite was excellent; there was no rise of temperature; the secretions were healthy, and the excretions regular; there was no change in the organs; the urine was normal. He was now receiving twelve drops of Fowler's solution hypodermically administered each day. Everything went well until July 1st, when it was noticed that the condition was undergoing a change. The skin assumed a shade of light bronze, especially pronounced on the back, the chest, and hypogastrium, and three growths suddenly appeared, one on the scalp and two on the back.

On July 7th it became necessary for him to return home. However, he continued the treatment during his absence, and returned on July 10th, when another lymphatic enlargement ensued, involving the inguinal glands on the right side, which were greatly increased and seemed hard to the touch. The largest of the cervical chain, which was apparently encapsulated, was now extirpated. Its contents were quite soft, appearing very much as if they had undergone mucoid degeneration. At the same time a change took place in the general condition of the patient. His physique was less robust and his gait less sprightly; he seemed drowsy, stupid, and weak; the mucous membranes began to show paleness; the enlarged glands manifested an appreciable increase, as did many others not previously affected. Those under the ramus of the lower maxillary gained the most, causing a pressure which provoked a cough. Expectoration was increased. Petechiae appeared for the first time upon the shoulders. Fresh hemorrhages, which encroached upon the back and chest, occurred daily, gradually extending down the arms. These hemorrhages developed slowly and were limited to the localities mentioned. The greatest number of confluent lesions was formed upon the chest. In certain regions they were thick and circumscribed, or of a linear configuration, and at every new outbreak were conspicuous, red, and bright. In size they varied from a pin's head to a pea, well defined, and uninfluenced by pressure. During the ten days following their original manifestation both sides were profusely studded with them. They were also present upon the eyelids and conjunctivæ; the ophthalmoscope revealed their existence on the retina of each eye and showed that the bloodvessels were dilated and tortuous. Pigmentation was marked and rapidly increased. This was especially pronounced over the hemorrhagic area. In fact, the entire surface showed both a rapid transformation and a decided increase in color, the earlier idiopathic pigmentary spots becom-

ing so dark as to resemble nitrate of silver stains. Many of the spots on the chest coalesced, and, the skin becoming generally pale, the contrast was naturally great. There were no evidences of pigmentation in the mouth.

An erythematous discoloration was also in evidence, especially well defined upon the arms. This readily disappeared upon pressure. From these prominent changes in the skin it was naturally concluded that the blood might demonstrate equally definite alterations. The mucous membranes and the finger-tips exhibited a peculiar pallor. Nothing unusual was found upon physical examination, with the exception of a systolic murmur. Pulsation of the bloodvessels of the neck was clearly visible, those of the temporal region being especially conspicuous. A provisional diagnosis of lymphatic leukæmia was made, and the blood examination resulted as follows :

Hæmoglobin	40 per ct.
Specific gravity	1,043
Red cells	1,936,000
Macrocytes present in moderate numbers.	
Microcytes the same.	
A few poikilocytes.	
Red cells somewhat pale.	
102 normoblasts to the cubic millimetre.	
White cells	34,000
Small lymphocytes	95.5 per ct.
Large lymphocytes	0.7 "
Eosinophiles	0.4 "
Polymorphonuclear neutrophiles	3.4 "

The lymphocytes varied somewhat in size, the majority, while conforming to the normal contour, were of greater dimensions than those of the ordinary cell.

The physical examination now made revealed no appreciable rise in temperature, yet the pulse recorded 110 beats per minute. A slight fulness in the left epigastric region was noticeable, and the spleen was somewhat enlarged, the estimated perpendicular diameter being about ten centimetres above normal. The organ was apparently smooth ; both deep pressure and percussion over the sternum proved painless.

July 18th. The glands about the neck, having rapidly augmented, became distinctly individualized, and resembled a festoon which swept around the inferior maxillary bone and extended from ear to ear. With the exception of a few that were small the knots attained the dimensions of a hen's egg. Owing to their location and extraordinary proportion they were tender and sensitive, occasioning great pain and increased flow of saliva. The gums were blue, swollen, and spongy, with a tendency to bleed upon the slightest provocation. The teeth were covered with sordes, and the lips were dry. In connection with this peculiar enlargement, soreness of the throat set in, which, in the form of a hypertrophy, was mostly limited to the tonsils. These within a week grew to such an extent as to impinge upon each other. The thyroid gland was not apparently involved. The patient became easily fatigued, his appetite was impaired, and he could not sleep. There was some dyspnea, with a frequent cough, due, in all probability, to the enlargement of the tonsils. An analysis of the urine showed it to be about normal in color ; acid reaction ; specific gravity 1020 ; no

albumin; no sugar; yellowish-white sediment; no casts; uric acid crystals; uric acid 0.784 grammes.

19th. The patient was now confined to the house. Following a severe paroxysm of coughing the purpuric eruptions appeared for the first time upon the cheeks, neck, and back; heretofore they were almost invariably found only upon the chest. Morphine was administered with little or no effect. The gums continued to swell until they nearly covered the teeth, ulcerations were discovered surrounding the bicuspids, and the bronzing of the skin became more and more pronounced.

20th. The patient appeared weaker and more languid, was still sleepless, and complained bitterly of pain about the region of the neck. His temperature was 99.5°, pulse 120, with a slight outbreak of purpura.

21st. Condition unchanged. Examination of the blood showed that microscopically it was pale and thin; coagulation took place slowly and irregularly.

Red cells	1,776,000
Microcytosis and macrocytosis fairly marked.	
Poikilocytes in fairly large numbers.	
Nucleated cells 225 to cubic millimetre.	
A number of polychromophiles.	
White cells	45,000
Small lymphocytes	95.3 per cent.
Large lymphocytes	1.6 "
Polymorphonuclear neutrophiles	2.3 "
Eosinophiles	0.6 "
Myelocytes	0.2 "

Temperature 99.8°, pulse 124. The lower lip became suddenly œdematosus, increasing to three times its natural size.

22d. Nausea and vomiting, with an outbreak of purpura in close proximity to the hairy scalp. No new spots on the body. Deafness of the left ear, accompanied by roaring and ringing, the result of hemorrhages in the meatus and on the tympanum.

23d. The hemorrhagic eruptions gave evidence of becoming paler, and after the lapse of three days had almost entirely vanished; restlessness increased.

26th. The pain in the throat was augmented, especially during deglutition, the right tonsil having become ulcerated. The ulcer was as large as a five-cent piece, well defined with sloughing edges. The œdema of the lips had sensibly diminished. The general tumefaction of the lymph nodes that was so characteristically marked had begun to subside. This was especially true of the glands beneath the inferior maxillæ. Temperature 100°, pulse 140.

27th. At one o'clock in the morning the patient was subjected to severe retching and vomiting. On the following morning the entire cutaneous surface was much reddened, with subcutaneous hemorrhages, affecting even the loose cellular tissue of the eyelids. Patient swallowed with difficulty; external pressure over the tonsils caused great pain. New symptoms appeared in the form of diarrhea and dark-colored urine. The abnormal color in the urine disappeared the same day, but the stools were frequent and copious and continued until the day following. The glands had materially decreased. Urine passed, 2040

grammes; specific gravity, 1021; uric acid, 1.44; slight amount of albumin, no sugar.

28th. Symptoms more intensified; condition weaker and much depressed; the ulcerated tonsil extremely sensitive. Patient vomited at noon; retching not marked; no purpura followed. Temperature 104°, pulse 140. The urinalysis of specimen passed in twenty-three hours showed the amount to be 2940 grammes; specific gravity, 1023; color high; aromatic, but not disagreeable; reaction acid; urophen and indican increased; urea, 39.403; uric acid, 2.64; sulphates, 9.364; phosphates, 3.470; no bile pigment; no sugar; no albumin; sediment consisted of squamous epithelial cells, probably of urethral origin; red cells not detected; leucocytes plentiful; a few hyaline casts; sediment thickly covered with uric acid crystals. Bacteriological examination by swab from throat revealed streptococci and various other micro-organisms.

29th, 8 A.M. No appreciable change in patient's condition except that he was more depressed. Pulse 150, temperature 104°. At 5 P.M., pulse 160, temperature 105°, pulsation of the carotid distinctly visible; no desire for food; extremely weak; slough on tonsil mostly gone; its edges and base were bright red, while the adjacent mucous membrane was pale. Patient complained bitterly of lancinating pain on the inner side of instep. Spleen showed no increase, as before. Percussion over the sternum no longer painful. The amount of urine voided for the past twenty-four hours was 3240 grammes; specific gravity, 1021; uric acid, 4.94 grammes. At midnight, temperature 106°, pulse 160, respirations 50. Epistaxis discharge usually pale; evidence of coagulation where it came in contact with the towel. The bleeding ceased at 1 o'clock. Patient complained of pain over the plantar arch of both feet.

30th. In the morning patient not so restless, but much weaker; pulse 160, temperature 106°, respirations 40 to 50. In the evening he was decidedly weaker. Pulse 180 and very thready, temperature 107°. Sponge-baths continued as the only means of effecting any relief. Patient complained of discomfort in his right hand, which was more or less œdematosus on dorsal surface; the same was true of the free border of the ribs on the right side of body. Mouth parched; bowels moved involuntarily; the lymph nodes could only be detected upon palpation. The blood examination twenty-four hours before death demonstrated that it was very thin and pale, with only a suggestion of coagulation. For this purpose it was taken from lobe of left ear, and gave the following results:

Red corpuscles	803,000
Leucocytes	1,600
Specific gravity	1030
Hæmoglobin	30
Normocytes pale, microcytes moderate number.	
Megalocytes large number.	
Poikilocytes.	
Schistocytes few.	
Normoblasts none.	
Blood-plates increased.	

The following relation existed among the leucocytes:

Small lymphocytes	88 per ct.
Lymphocytes (transitional and large)	1 "
Polymorphonuclear neutrophiles	10 "
Eosinophiles	1 "

The last examination (incomplete) was made ten hours later, or just before death. This revealed a remarkable reduction of the leucocytes, namely, to 600 per cubic millimetre. At midnight the pulse was weak, rapid, thread-like, and intermittent; temperature approached 108°, respirations 38, and tubular in character; heart sounds almost inaudible; general condition greatly relaxed and very feeble. At 2 A.M. patient powerless and flaccid; temperature still elevated; at times slightly delirious, but when spoken to would answer intelligently; heart sounds inaudible; respirations gradually diminishing; easy death at 3.30 A.M.

Autopsy Notes. An autopsy was made eight hours after death by Dr. Herbert U. Williams. Body fairly well nourished; rigor mortis quite firm; pigmentation of the skin over the upper part of the chest and back and distributed irregularly, that upon the chest most marked, the patches being about the size of a dime. In other places they had coalesced and had formed irregular patches. The rest of the skin covering the body presented a dark-gray appearance. Petechiae appeared upon the chest and were isolated near the pigmented border, although confluent toward the centre. There were three small tumors in the skin covering the abdomen. On section they showed a whitish appearance. Some superficial lymph nodes gave evidence of enlargement upon palpation. The cervical, supraclavicular, and inguinal were the most pronounced, although manifesting a marked decrease in size compared with their dimensions before death. They were of firm consistency and freely movable. The subcutaneous adipose tissue was small in amount.

Thorax. The pleural cavity contiguous to the smaller bronchi was studded with lymph nodes about the size of a pea. The peribronchial lymph nodes varied in size from a pea to a chestnut. Upon repeated sections they looked like raw flesh, apparently the result of hemorrhages. No caseation was present. The thymus gland was patent.

Lungs. Lungs somewhat dry, pale, and presented nothing of interest except a few small superficial hemorrhages. The pleural cavities contained no fluid.

Heart. The pericardium contained about three ounces of perfectly clear serum; the parietal layer was covered with minute petechiae. The lymphatics of the outer surface of the heart were dilated with lymph to the size of a straw. The right ventricle was distended, containing a pin clot and a small amount of blood. The left ventricle was contracted and nearly empty; its posterior wall had a petechial spot. The heart muscle was firm and pale, and the valves were all in a normal condition. The peritoneal cavity contained a small quantity of serum, but was otherwise apparently normal. The omentum was distinguished by enlarged lymph nodes which were about the size of a small pea. The retroperitoneal lymph nodes also showed definite enlargement.

Stomach. The various layers appeared normal, with the exception that throughout they were studded with enlarged lenticular follicles about the size of a French pea.

Intestines. The contents consisted of a semi-fluid, yellowish-white milk stool. Marked hypertrophy of the mesenteric lymph nodes was noticed. These varied in size from a pin-head to a pea. The solitary

follicles were enlarged. Near the ileocaecal valves Peyer's patches showed thickening. The vermiciform appendix was normal.

Spleen. Weight, one-half kilogramme. On section trabeculae not distinct. Malpighian bodies large and well marked.

Liver. Weight, two and one-half grammes. Smooth and pale in color. On section very coarsely mottled with varying shades of red, corresponding with areas comprising several lobules. A substance covered the diaphragmatic surface which looked like fibrin. The gall-bladder contained about 43 grammes of pale bile, otherwise normal.

Kidneys. The ureters were normal. The left kidney was large and soft, weighing about 175 grammes. The capsule was pale and covered with petechiae, and was easily stripped off: cortex very broad, having a swollen and hemorrhagic appearance. The cortex was covered with peculiar pale-gray streaks. The right kidney was the same as the left. Suprarenal bodies normal.

Bone-marrow. The bone-marrow of the sternum was slightly paler than normal.

Bacteriological Examination. During life the following examinations were made: Portions of the tumor removed from the breast were placed in the peritoneal cavity of live dogs. The blood of the animals was examined at two different times without any change. Four months later the dogs were killed and the blood was found to be in a healthy state. No enlargement of the lymph nodes or other abnormal condition was noted.

Inoculations made from a tumor into various culture media unfortunately became contaminated. There was difficulty in getting cultures from the skin. Swabs on agar made from the ulcer of the throat three days before death, placed in the incubator and examined after seventy-two hours, showed various cocci and bacilli, among them numerous streptococci. Examination in sections of the tumors removed during life for bacteria, also of the blood for the parasites described by Lovett, were negative.

The following results were obtained at the post-mortem: Smears made from the various organs were all negative, with the exception of those made from the spleen, which showed the streptococcus only sparingly. Cultures, including anaërobic, were made on different media at the post-mortem and placed in the incubator. The cultures on agar were made from the lung, blood of right and left ventricle, liver, kidney, bronchial lymph node, post-peritoneal lymph node, spleen and bone-marrow. Cultures from the bone-marrow and lymph nodes were also made on human blood serum. Streptococcus pyogenes were grown from all the organs. The staphylococcus pyogenes aureus was recovered from a bronchial lymph node along with the streptococcus. The post-peritoneal lymph nodes showed an organism resembling bacillus coli communis, and the kidney a large bacillus resembling the hay bacillus. These were regarded as post-mortem invasions without significance.

Histological Examination—Cutaneous Lesions. For the microscopical investigations made during life, in addition to the material obtained from the initial lesion on the forehead after its removal, fragments were also procured from the affected skin surrounding the left nipple, from the patch located over the sternum, and from another patch situated upon the abdomen. These were hardened in substances conventionally recognized for such purpose. The paraffin sections cut therefrom were stained by the usual method. These various sections showed micro-

scopically that the tumor was essentially of a similar structure throughout. The fundamental tissues largely consisted of lymphoid cells. The growth proper principally occupied the structure of the cutis and subcutaneous tissue. Its greatest development took place in the vascular reticulum of the latter. The cellular infiltration was so great that it pressed apart the normal structures. The cells of the adipose tissue were widely separated by this diffuse process, and the layers much increased in thickness. In the superior partis vascularis of the corneum, at the periphery of this growth, there was comparatively no infiltration, while it was exuberant and characteristic about the inferior partis vascularis and around the bloodvessels adjacent to the subcutaneous tissue. The thickness of the infiltration varied considerably, reaching as high as 2 cm. These abnormal cells were usually round, except where the shape was modified by pressure. They consisted of a homogeneous protoplasmic rim which took acid aniline stains and a relatively large, round nucleus. Each nucleus seemed to possess a membrane, and a distinct round nucleolus occupied its centre. No mitoses were seen. The nuclei possessed a characteristic network, forming a rim with numerous dark points within it. Certain stellate cells, probably connective-tissue, were found, possessing large protoplasmic bodies and yellow pigment granules. These were not always present, although found in the majority of specimens of the true skin and subcutaneous tissue. The deep epithelial cells were generally pigmented. Isolated masses of pigment were found in all the growths investigated, and were especially prominent in the deep-seated parts. In looking over the sections that were stained with polychrome methylene-blue for mast cells they were seldom detected either among the cells of the tumor or connective tissue. Plasma cells were never discovered. The haematoxylin stain demonstrated the presence of numerous homogeneous bodies of irregular or roundish contours, with a well-defined nucleus, that were much smaller than the tumor cells. They took the dye deeply, were well outlined, and were most frequently encountered in the true skin, less often in the connective tissue, occasionally in the striped muscles, and but rarely in the centre of the tumor. In structure and appearance they closely resembled the parasites claimed by some writers to exist in certain tumors as well as in connection with other affections. They might, however, have been the result of nuclear degeneration. Many sections showed small clusters of three to six in the reta cells, which had apparently lost their prickles, yet their nuclei were well stained. If these bodies were the products of degeneration those found in the muscle must have been derived from the muscle-cells, those in the connective tissue were probably disorganized nuclei, and those of the tumors may possibly be regarded as the result of nuclear degeneration.

The trabecule of the connective tissue in the new growths consisted of a reticulum of interlacing bands, or fibres, least conspicuous where the infiltration was intense. This reticulum contained the lymphoid cells, and the whole arrangement was suggestive of a lymphadenoma. Using Weigert's stain for elastic tissue, elastic fibres could easily be demonstrated in the neoplasm. Especially was this true in those portions of the growth where the process was most active. The elastic fibres were rather more numerous in the large tumors. They were most abundant about the sweat-glands and hair-follicles. In the walls of the bloodvessels, wherever there was any thickening, the elastic tissue was

apparently augmented. The arteries in the tumor masses sometimes showed a thickening of their walls from an infiltration with lymphoid cells. This process was most marked where the tumors were the largest.

Early in the infiltration the integrity of the hair follicles and their appendages were well maintained, but later on they were surrounded by an accumulation of round cells, when their outer sheaths became infiltrated and finally obliterated the follicle, the hair alone remaining.

The alterations in the sudoriferous glands varied with the location. Those in contact with the tumor showed the reproductive nucleated cells within the lumen to be swollen, and at times completely filled the duct. Later they became so modified and disarranged as to be confused with the neoplastic cells. In those portions of the neoplasm most highly developed they were entirely obliterated.

The sebaceous glands seemed for a long time to resist the infiltration, but when completely surrounded and penetrated by the new-growth cells were apparently made to disappear.

Every layer of the skin was infiltrated, with the exception of the stratum corneum, this being somewhat modified by the pressure of the cellular infiltration from beneath, varying much in thickness, from a few cells in some localities to the normal condition in others. In no instance could the cells of which the tumor was composed be found to infiltrate the epidermis. There was no evidence of porokeratosis or desquamation. The changes noted were important, in that they were characteristic of the disease under consideration. The rete mucosum in certain places was much altered and varied so greatly as to force the conclusion that these changes were secondary to the tumor formation. The interpapillary processes were obliterated by pressure. Not a few of the prickle cells were more or less swollen by reason of oedema of the interepithelial spaces. Here and there in the rete were vacuoles. In these free spaces leucocytes could occasionally be seen. The stratum granulosum was conspicuous and consisted of two or more layers, while the stratum lucidum could only be recognized at certain points. The pigmented skin, which was free from tumor, showed a pronounced increase of thickness in the granular layer, which encroached upon the stratum mucosum. The pigment consisted of brownish-yellow or black granules, uniformly deposited, which could likewise be detected in the ducts of the sudoriferous and sebaceous glands.

Internal Organs (Microscopical). On microscopical examination of the tissues of the various internal organs, which were placed in Zenker's fluid at the time of autopsy, the leukæmic infiltration was found to have affected all the organs. It was not, however, as pronounced as in the masses taken from the skin.

The bronchial lymph nodes showed a great increase of the cellular elements. The capsules were thin, and there was no evidence of inflammation around the nodes. Adjacent to these were many hemorrhages and numerous pigmented cells. Hemorrhages were discovered in the nodes, and there were numerous red blood-corpuscles among the lymphoid cells. The lymph channels all through the nodes were packed with red corpuscles and lymphocytes; occasionally large flattened cells appeared. Many of the larger cells contained pigment. It was rare to see two or three nuclei. Some of the lymph channels were crowded with pigmented cells; the larger of these rarely contained red corpuscles or lymphocytes. Numerous irregular masses, stained blue by

Gram's method, about four times as large as the lymphocytes, were found, which appeared to be some hyaline substance. Many groups of lymphocytes showing fragmented nuclei were noted. Occasionally a mass of cocci was seen, some of which when stained by Gram's method proved to be streptococci. The groups of cocci failed to show any relation to the cells having fragmented nuclei. Masses of cocci were also found inside of the veins, others in the capillaries. Certain veins showed thrombi composed of mixed layers of lymphocytes, red corpuscles, blood-plates, and fibrin. Sections of the abdominal lymph nodes revealed substantially the same changes as those made in the bronchial nodes (or glands), and sometimes large multinucleated phagocyte cells abounded. In certain cases the adipose and areolar tissue about the nodes contained numerous lymphocytes. Evidences of hemorrhages in and around these nodes were frequently discovered.

Spleen. In sections of the spleen it was found that the changes were similar to those in the lymph nodes. The capsule was normal. The Malpighian bodies were numerous, distinct, and enlarged, often being twice the normal size. They also contained normal-looking lymphocytes and great numbers of large flat cells. The splenic pulp was crowded with lymphocytes. There were occasionally fragmented nuclei as well as numerous cells with very large nuclei, or with several nuclei (two to five). These sometimes contained pigment. Mitosis, polymorphonuclear plasma cells, or mast cells were rarely seen in this or any other section. One very large phagocytic cell contained eight other cells with degenerated nuclei. Numerous masses of cocci appeared in the spleen pulp, and at times short chains could be distinguished. There were no eosinophilic cells.

Bone-marrow from the Sternum. On microscopical examination the marrow cells and nucleated red corpuscles were found comparatively few. Lymphocytes were present, but not conspicuous. Preponderance of small mononuclear cells, slightly larger than red corpuscles, could be seen. Some large cells resembling endothelium cells were discovered. The eosinophilic cells were few. There were some doubtful giant cells. Fragmentation of nuclei was not pronounced. Some groups of cocci were seen.

Heart. Many lymphocytes were seen. Fragmentation of nuclei was detected. The heart muscle was not remarkable. Single lymphocytes lay between the muscle cells. In the lymphoid spaces collections of minute lymphoid cells were discovered. No bacteria.

Lungs. No evidence of bronchitis, pneumonia, or pleurisy. The outer layers of the bronchi, especially the smaller bronchioles, as well as the alveoli, were richly infiltrated with lymphoid cells. There were hemorrhages in the submucosa of the main bronchus, and in the wall below the epithelium a cell infiltration, mostly consisting of lymphocytes, together with plasma cells. There was a similar increase of cells in the walls of the bronchial tubes. Lymphoid cell deposits were found between the mucosa and submucosa and throughout both layers. There were plasma cells mixed with red corpuscles in the mucous membrane, although less numerous than the lymphoid cells. Several thrombi of leucocytes and fibrin were discovered in the various arteries.

Liver. The capillaries were distended with (chiefly) red corpuscles. There was also a lymphoid infiltration extending along the portal spaces and pushing out between the liver cells. Inside of the capillaries

emboli of micrococci were often to be seen, but there was no evidence of inflammatory action in their vicinity. Considerable light brown granular pigment was present in the liver cells.

Duodenum. The solitary follicles were composed of cells of the lymphoid type and plasma cells in moderate numbers, the last not striking. Between the glands the lymphatic tissue was but slightly increased.

Colon. The solitary follicles were large and numerous. In many of the lymph channels of the submucosa lymphocytes were found in large numbers. Evidences of hemorrhages and numerous bacteria, probably saprophytes, were found in the mucous membrane.

Kidneys. The lymphatic collections were most marked in the cortex at its junction with the pyramid. They were sometimes seen about the veins and, in rare instances, apparently in the sheath of the vessel. This was a marked feature shown in all sections examined. The convoluted tubes contained reticulated coagulum, which was also seen around the glomeruli. These were occasionally compressed. In many sections lymphocytes were seen between the cells of the tubules. The nuclei of the epithelial cell stained well.

Pancreas. The fibrous tissue surrounding and adjacent to the pancreas was edematous; many loose red corpuscles were seen in it. There was some infiltration with small nucleated cells. No evidence of pigmentation from previous hemorrhages. The ducts and the glandular parts of the pancreas were normal. The cells of the infiltration were found to be large lymphocytes. Fragmented nuclei were only exceptionally seen. There was infiltration with lymphocytes close to the pancreas, resembling lymphoid tissue and apparently not connected with lymph nodes. No bacteria were detected.

Adrenal Bodies. No special change was noted and no bacteria were found.

Thymus Gland. The connective tissue about the gland showed marked hemorrhagic infiltration, which appeared recent, as well as a few yellow pigment granules. Hassall's corpuscles were large and distinct. The thymus gland possessed numerous ordinary lymphoid cells. The distinction between cortex and medulla was barely discernible. The adjacent connective tissue contained lymphocytes, which seemed to pass from the thymus proper to the adjacent tissue. A few eosinophiles were discovered. No fragmented nuclei were apparent; a few hyaline bodies were seen. The capillaries contained masses of streptococci.

A point worthy of note was that throughout the lymphoid structures appeared areas of nuclear degeneration and fragmentation. Although the nodes contained emboli of micrococci, the areas of fragmentation showed no relation to the bunches of cocci. It may be presumed, therefore, that the degeneration was due to toxins formed by the micro-organisms rather than by direct action of the organism upon the cells.

This case is a striking illustration of leukæmic changes, especially in their relation to the skin. The tumor formations originated in the hypoderm and terminated in nodules, and were readily discovered by palpation. Frequently they would spontaneously disappear, or were compelled to do so under the influence of arsenic. Later, however, when they began to involve the superficial layers of the skin and to become elevated they manifested a disposition to become permanent—

more so than when deep-seated. The color of the skin overlying the lesions was practically normal, while over those in which the superficial layers of the skin had become implicated it was first red, then violaceous. These sequences, however, were not absolute, for, occasionally, the several shades were tinged with hemorrhagic streaks. The size of these deep-seated nodules was that of a hazel-nut. The deeply buried lesions were practically oval; the superficial ones were also oval, but were more or less flattened, or pad-like, and covered a considerable surface.

Cases of leukæmic infiltration of the skin have been recorded in medical literature since 1876, first by Bisiadecki,¹ followed by Hochsinger and Schiff,² Philippert,³ and Oliver.⁴ Most prominent among the more recent reports of excessive leukæmic growth may be mentioned the case of Kreibich,⁷ who reports that the pendulous masses, which varied in size from a pigeon's egg to the adult fist, were found upon the face. The history of the majority of cases recorded shows that this locality is the common seat of leukæmic invasion. However, in the case under consideration, they predominated upon the chest. In referring to their frequent occurrence upon the face, Pinkus⁶ argues that the explanation lies in the fact that this part of the body lacks protection from external injuries, or that it may be due to a better blood-supply. From my own observation of the present case I venture the opinion that it sustains the theory of infection. In this instance the infection possibly originated at the site of the initial appearance of the disease, which was upon the forehead, and it took place long before there was any lymphatic enlargement. From the excellent résumé of Pinkus it would appear that all such tumor-like formations occurring in the skin are clinically and histologically identical, for he makes no distinction between those found in lymphatic leukæmia and those in pseudoleukæmia. Microscopically, the cutaneous alterations of the present case correspond with the findings of Kreibich, Nékám,⁸ Pinkus, and Oertel,⁵ who considered the microscopical structure analogous to lymphocytes deposited in the skin. In the case now discussed there was no marked suggestion of mitosis. The cells in size and form were identical with the lymphocytes, and were usually discovered within the walls of the vessels. It was observed that the cells were first lodged within the meshes of the corium, in close relationship to the subcutaneous tissue. The fact that a small number of lymphocytes were congregated about the bloodvessels in apparently normal skin—observed by Kreibich—was also noticed in the present instance.

One of the most striking features of the case, in the earlier stages of the disease, was the pronounced change in the complexion. The countenance assumed a vivid tinge of pink that challenged attention. This abnormal hue was undoubtedly of a hæmatogenous character. Another symptom of note was the dual pigmentation, depending upon several

causes. First, we had the idiopathic pigmentation, which appeared early in circumscribed areas, while the physical condition of the patient was still unimpaired. Its initial color was yellow, but the older the areas the darker they grew. There was no inclination on their part to coalesce. Second, we had a secondary pigmentation which was more or less general, covering the entire chest and back to such an extent as to efface all traces of the first, existing in discrete and isolated patches. This was purpuric in character, and appeared in various shades of brown and black.

In reviewing the blood examination many interesting points may be recorded.* The most noteworthy were the blood changes, apparently demonstrating the development of lymphatic leukæmia from pseudoleukæmia, and showing that the blood upon the first examination was practically normal, not even revealing any marked diminution in the haemoglobin. It was only when the case was advanced that a leukæmic condition was determined. However, the apparent transition of the pseudo type to that of the lymphatic was quite abrupt. The transmutation of pseudoleukæmia into genuine leukæmia is known, but is exceedingly rare. Reference may here be had to the cases reported by Mosler,⁹ Fleischer and Pentzoldt,¹⁰ Troje,¹¹ and Cabot.¹³ Pentzoldt mentions a form of lymphatic Hodgkin's disease different from the ordinary variety of pseudoleukæmia which may result in true leukæmia. In comparing the first blood examination with the second the only noticeable change was in the number of leucocytes with secondary anaemia—the principal argument for the separation of pseudoleukæmia and lymphatic leukæmia. The same augmentation was manifest in the second and subsequent examinations. The only difference was in quality. After the second analysis the alterations in the skin showed the same clinical features. There was apparently the same general swelling of the lymph glands, the same cutaneous pigmentation and tumor formation, with the absence of any special enlargement of the spleen or any other internal organ. However, the patient appeared

* While the title of this paper sufficiently indicates the writer's own interpretation, he is, nevertheless, fully conscious that there is room for a legitimate difference of opinion concerning the case. That could hardly be otherwise, so long as the classification of lymphosarcoma and pseudoleukæmia is so indefinite and unsatisfactory as at present. The question is sure to arise whether the facts of this case really justify the diagnosis of pseudoleukæmia developing into true leukæmia. The blood was at first normal, without leucocytosis or relative lymphocytosis. It subsequently changed to the picture of leukæmia, with leucocytosis and high relative lymphocytosis—96 per cent. lymphocytes. The affection at first was either pseudoleukæmia or aleukæmia. Considering the limitations of our knowledge regarding the occurrence of an aleukæmia in the presence of physical signs of leukæmia (*i. e.*, glandular swelling) as a preleukæmic stage of true leukæmia, we prefer to take our stand on the simple facts of the case and say that the case was at first not true leukæmia, but pseudoleukæmia. Our knowledge of this condition may, in the future, be so enlarged that we shall be required, before reaching a positive diagnosis of pseudoleukæmia by blood examination, to hold the case under observation for a considerable length of time, in order to exclude the possibility of the existence of an aleukæmia preleukæmia.

somewhat weaker, with a slight pallor of the visible mucous membrane, sufficient, however, to demonstrate that some important changes had taken place, and that we were dealing with a different type of leukæmia than that found at the first examination. There was a preponderance of leucocytes and an increase of the mononuclear elements over the polymorphonuclear neutrophiles, and a lack of myelocytes, all clearly certifying to the presence of lymphatic leukæmia. The further progress of the leukæmic stage showed a rapid loss of red corpuscles. The nucleated red cells also decreased, but, as the disease progressed, there was a considerable increase in the macrocytes. There was an enormous augmentation in lymphocytes, both relative and absolute, 95 per cent. of the 34,000 being small lymphocytes. A striking peculiarity of the case consisted in the fact that it ran its course with singular fidelity to its type until about one week before death, when severe soreness of the throat supervened, accompanied by grave constitutional symptoms. The temperature became unusually high, with rapid loss of strength, suggesting general infection. The enlargement of the lymphatic glands suddenly subsided, especially as concerned those about the neck, so that at the time of the patient's death they could only be detected by palpation. The blood showed, associated with this secondary infection, a drop from 45,000 cells to 600 per cm., with an increase in the proportion of polymorphonuclear neutrophile cells of 3.4 per cent. to 10 per cent., and a decrease in the proportion of lymphocytes of 95 per cent. to 88 per cent.—all within eight days. The infection was due to the streptococcus pyogenes, a fact corroborated by the bacteriological examination of secretions taken from the throat just before death, and verified by subsequent examinations made at the time of the post-mortem. The smeared preparations not only revealed the streptococcus, but it was also cultivated from the tissues procured from the various organs of the body. It has been recognized for many years that the most striking changes in leukæmia occur following secondary infections, to such an extent that all features of the blood are altered. Herrick¹⁴ reported a case of lymphatic leukæmia with a streptococcus infection beginning in the tonsils which was very much like the case under consideration. In acute leukæmia apparent improvement has been noticed, especially marked as to the leucocytosis, as the infection developed. In all probability it does not prolong life, as has been suggested, but only acts as a moderating agent for the time being. It is interesting to note the analogies which these phenomena present with the disappearance of sarcomata after the injection of the toxins of the streptococcus, as reported by Coley. Of the two cases reported by Fraenkel,¹⁵ one on March 6th showed the presence of 89,000 leucocytes, consisting principally of lymphocytes. On March 21st the streptococcus infection was discovered, and on March 26th the number of

leucocytes had decreased to 6000. In the second case following the infection the leucocytes decreased from 22,000 to 1200, yet death was the ultimate result in both cases. In other well-known recorded cases, as, for instance, Muller,¹⁶ the leucocytosis fell from 246,900 to 57,300; in Kovács,¹⁷ from 67,000 to 17,000; in Zeissl's,¹⁸ from 140,000 to 9350; Cabot's, from 40,000 to under 500; Kormoczi, from 20,000 to 1000. In most of these cases there was also a diminution in the size of the spleen.

The unusual increase of the uric acid eliminated in the present instance, notwithstanding the fact that it corresponded with that of the cases previously observed, deserves special mention. The urine was carefully studied during the last few days of the patient's life, after the intercurrent infection had become active. Previous examinations had shown the constituents of the urine to be about normal. The greatest amount voided at any time during twenty-four hours occurred between noon of July 28th and that of July 29th, being 3240 grammes, containing 4.94 grammes of uric acid. This unusual increase took place when the sepsis had reached its height. There was no special attention given to the quantity or quality of food throughout the whole course of the disease, other than for the last few days. After the onset of the sore-throat the patient took, daily, about three pints of milk, six ounces of whiskey, and four eggs, with an unlimited amount of water to quench the thirst accompanying the high fever.

There seemed to be a marked relation between the elimination of uric acid and the loss of lymphocytes in the blood, although the sudden decrease of all lymphatic gland structures must also be taken into consideration as well as the food. In this connection attention is directed to the areas showing nuclear degeneration found in the bronchial and other lymph nodes. An increase in the elimination of uric acid is, as a rule, noted in all cases of acute leukæmia ending in rapid destruction of the white cells, due to the sepsis or to infection. A. Magnus Levy¹⁹ has recorded the most remarkable phenomenon of this character, viz., 8.72 grammes in twenty-four hours. He also observed in the same case, as well as in a number of other acute cases, that there was a large amount of urine and an increase of total nitrogen and uric acid.

I desire to express my sincere thanks to Dr. Herbert U. Williams for his kind assistance in the preparation of this article, and to Dr. Albert Woehnert for making the blood examinations.

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THE LYMPHOMATOUS TUMORS
OF THE DOG'S SPLEEN

HERBERT U. WILLIAMS., M.D.,
AND
FREDERICK C. BUSCH, M.D.
(Medical Department, University of Buffalo)

THE LYMPHOMATOUS TUMORS OF THE DOG'S SPLEEN.¹

HERBERT U. WILLIAMS, M.D., AND FREDERICK C. BUSCH, M.D.

(*Medical Department, University of Buffalo.*)

Although primary tumors of the spleen are rare in man, this is not the case in the dog. The observations of the writers are based on autopsies on seven hundred and twenty apparently healthy dogs. In seventeen of these, or two and one-third per cent, tumor-like nodules were present in the spleen. None of the dogs gave macroscopic evidences of leukemia or pseudo-leukemia, or showed enlargement of lymphatic glands or other lymphoid structures; nor were lymphoid deposits visible in other organs.

The number of tumors seen in a single spleen varied from one to seven. In one case moderate enlargement of most of the Malpighian bodies co-existed with the splenic tumors in question. Two or three enlarged Malpighian bodies were a few times detected in spleens containing the tumors, but this was not the rule. The tumors usually occurred in otherwise normal spleens.

In shape they were roughly spherical, in diameter from five millimeters to four centimeters. On section they proved to be composed of small, soft, white, translucent masses, resembling Malpighian bodies, but larger. They contained also a variable amount of a soft, dark red substance, looking like spleen-pulp or blood-clot, in which the translucent masses were embedded. The latter were found to consist of lymphoid tissue. The soft reddish substance appeared to correspond with the splenic pulp; in some tumors the amount of it was small; in its meshes were red blood-corpuscles and sometimes considerable masses of blood; it contained a very variable quantity of pigment.

With low magnification the structure of the tumors was

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seen to differ from that of the spleen in three important particulars:

1. In the absence of trabeculæ except at the edges.
2. In the large size of the lymphoid masses as compared with the Malpighian bodies of the normal spleen.
3. In the absence of a central artery in the lymphoid masses as a rule, though not invariably.

It is noteworthy that areas of necrosis or caseation were not encountered in the tumors.

In six cases microscopic examinations were made of the liver, kidney, and lung for deposits of lymphoid tissue. Nothing of the kind was found with the exception of a few small collections of lymphoid cells between the tubules of the kidney in two cases.

In four cases smears were made of the heart's blood; the results were not important.

In six cases bacteria were sought for in the tumors in stained sections and by cultures, with negative results.

Although a number of attempts were made to inoculate portions of the tumors into the spleens of other dogs, the circumstances were satisfactory in one case only. The results of this experiment were negative, the spleen showing nothing but small scars at the end of eleven and one-half weeks.¹

While collecting our material we encountered a number of cases of hemorrhages in the dog's spleen (*hemorrhagia intrapulposa subcapsularis*, Kitt), which superficially resembled the tumors above described. Sometimes it was even difficult to decide whether we were dealing with a blood-clot in process of resolution and being invaded by granulation tissue, or with a new growth of atypical spleen-pulp and lymphoid tissue. One such case, which we classified as hemorrhage, showed undoubtedly multiplication of the lymphoid elements remaining in the clot. The absence of trabeculæ from the genuine tumors and the presence of blood in them will be recalled. These facts suggested the possibility of a traumatic

¹ Incidentally to this work we secured an atypical adenoma of a dog's breast, pieces of which were introduced into a normal dog's breast while very fresh and having been kept warm. The wounds made healed quickly, but no growth resulted after seven weeks.

origin for some of the tumors, although the inherent improbability of this theory was appreciated. The absence of conspicuous pigmentation from the tumors was also an argument against this theory.

There seemed, however, sufficient encouragement to warrant our observing the progress of experimental lacerations. The results of the experiments in this direction (ten in all) were negative. When the spleen was well lacerated beneath the capsule and the capsule was torn away from the pulp, quite marked blood-tumors formed in a few minutes; no trace of them was visible after two or three weeks except a pigmented scar. The result was similar in two cases where the veins leaving the lacerated portion were tied.

The growths described above are not mentioned in many recent text-books on pathology. They are alluded to briefly in the well-known works of Orth and Birch-Hirschfeld. They are more fully described by Kitt.¹

According to Kitt, the lymphoid tumors of the spleen (excluding those which occur in leukemia and pseudo-leukemia) may be of two sorts:

1. A universal hypertrophy of the Malpighian bodies, with much enlargement of the spleen (*hyperplasia follicularis splenis*, *splenoma*, *splenadenoma*, etc.).

2. Circumscribed tumors of lymphoid tissue, which may be single or multiple (*lymphoma*). The names "malignant lymphoma" or "lymphosarcoma" are also used for the second variety, apparently when the tumors are multiple and produce great enlargement of the spleen. Both kinds are common in the dog, hog, cow, and horse. The tumors we have encountered seem, with one exception, to correspond with the second class mentioned, though their clinical tendencies were certainly not malignant. Apparently there are many links by which the two varieties are connected.

(We are indebted to Dr. A. T. Kerr, Assistant Professor of Anatomy, Cornell University, Ithaca, for furnishing us much material.)

¹ Lehrbuch der pathologisch-anatomischen Diagnostik für Thierärzte, Bd. ii., and Pathologische Anatomie der Haustiere, 2te aufl., Bd. ii., pp. 398, 404.

FIGURE 1.

Lymphomatous tumor of spleen; moderate size.

FIGURE 2.

Spleen with several lymphomatous tumors.

FIGURE 3.

Large lymphomatous tumor.

FIGURE 4

Section of tumor shown in figure 3

Diameter of the tumor, 4 c. m.

NOTE.—This article is an abstract of a more detailed paper which was included in the volume of "Contributions to Medical Research," dedicated to Doctor Victor C. Vaughn, 1903. The illustrations are part of those accompanying the same paper.

Fig. 4.

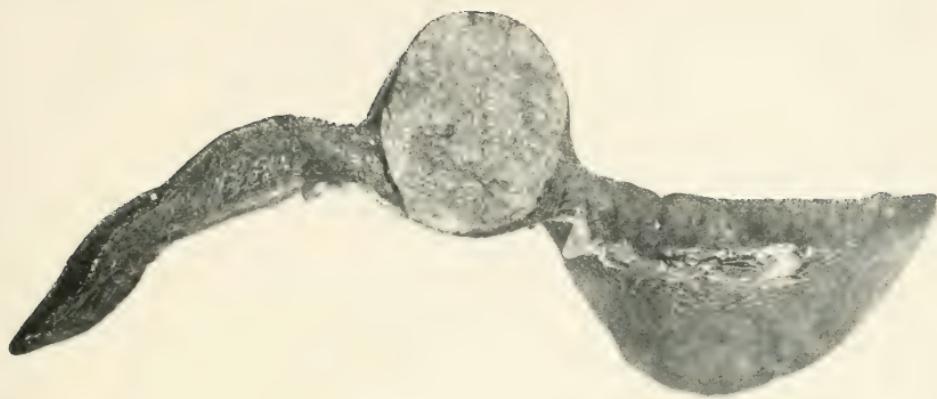


Fig. 3.



Fig. 2.



Fig. 1.



DOG'S BLOOD
DIFFERENTIAL COUNTS OF LEUCOCYTES

F. C. BUSCH, M.D., AND C. VAN BERGEN, M.D.

(From the Laboratory of Physiology, Medical Department,
University of Buffalo)

DOG'S BLOOD.—DIFFERENTIAL COUNTS OF LEUCOCYTES.

F. C. BUSCH, M.D., and C. VAN BERGEN, M.D.

(*From the Laboratory of Physiology, Medical Department, University of Buffalo.*)

The comparative morphology of the white corpuscles in the blood has been studied in a number of animals used for experimental purposes. The differential numerical relations of the leucocytes has been estimated in a few. This has been done for rabbit's blood by Brinckerhoff and Tyzzer¹ and for dog's blood by Dawson² and by Tallqvist and Von Willebrand.³ Believing that further work along similar lines would still be of value, the writers feel justified in adding another series of counts to those which have already been made.

The present series includes differential counts of the leucocytes in the blood of twenty dogs, all apparently normal, so far as could be ascertained, in many instances, by post-mortem examination. In the majority of cases, counts of the red corpuscles, and in all cases, of the leucocytes were made. The blood was taken at least twelve hours after feeding. The blood smears were stained by Ehrlich's triple stain; by eosin and methylene blue; by Jenner's stain; by Leischmann's stain; by Unna's polychrome-methylene blue; and by Dahlia for mast cells.

As a rule the counts of the leucocytes, stained by the various methods, agreed very closely. The table, therefore, represents an average of the counts made from the various stains.

It may be of value to mention a few points in the technic of staining by the various methods. With eosin-methylene blue the results are not uniform. Usually the nuclei and granules alone are stained; occasionally the cell body also. When this occurs the results are as good as those obtained by any other stain. Much depends on the fixation of the

Journal of Medical Research, Vol. 7, No. 4.

²American Journal of Physiology, Vol. 4, No. 1.

³Skand. Archiv fur Physiologie, 1899, ix, p. 37.

smear, which is preferably done by alcohol and ether. With Ehrlich's triple stain the nucleus can be better differentiated by treating the stained and dried smear, from one to three seconds, with a saturated aqueous solution of methylene blue as used by Hewes.¹ With Jenner's stain,² the results depend largely on the care exercised in washing and drying. The smear, which has been dried in the air (no previous fixation required) should be flooded with the stain for about three minutes and then washed by gentle agitation in a dish of distilled water until the specimen has attained a pink hue. Tap water should not be used. After washing, the smear should be allowed to dry in the air or by gentle warming. Blotting paper should not be applied. Leischman's method³ gave uniform and satisfactory results. The application of this stain is, briefly, as follows: To the dried smear three or four drops of the stain are added and evenly distributed over the blood film. After about half a minute the stain on the cover-slip is diluted with six or eight drops of distilled water. After staining about five minutes, in the case of thin films, the stain is gently washed off in distilled water and the water allowed to remain on the film for a minute longer. The smear is then ready for examination, either directly in water or after drying (without heat) and mounting in xylol balsam. With this stain the nuclei of the colorless corpuscles are sharply differentiated, taking a deep ruby red, while the extranuclear protoplasm remains unstained, with the exception of the mononuclear forms which may take a pale blue tint.

The leucocytes have been classified under the following headings:

Polymorphonuclear, lymphocytes or small mononuclear, large mononuclear, eosinophiles and mast cells.

DESCRIPTION OF CORPUSCLES AS STAINED BY THE VARIOUS METHODS.—With eosin and methylene blue, the nuclei

¹ Journal of the Boston Soc. of Med. Sciences, Vol. II, p. 70.

² Lancet, 1899, Vol. I.

³ Leischman. A simple and rapid method of producing Romanowsky staining in malarial and other blood films. British Med. Journ., 1901, Vol. II, p. 757.

(Modified by James H. Wright. The Journal of Medical Research, Vol. VII, p. 138, 1902.—Editor.)

of the polymorphonuclear leucocytes and of the lymphocytes stain a deep sky blue, and of the large monuclear forms a lighter blue. Eosinophile granules stain bright red. The cytoplasm either does not show at all or is tinged a faint pink. With Ehrlich's triple stain, the nuclei of the polymonuclear forms take a dark blue or a blue-black, of the large mononuclear forms a light blue, and of the eosinophiles a still lighter blue. The eosinophile granules are stained a purple red. The cell body is stained a reddish brown. With Jenner's stain, the nuclei of all the forms are stained a light blue and the cytoplasm a light pink. The eosinophile granules take a bright red. With Leischman's method, the nuclei are stained ruby red and the cell bodies a faint terra-cotta or remain colorless.

FORMS OF LEUCOCYTES.¹—The polymorphonuclear leucocyte is the most frequent form found in dog's blood. The cell, in cover-glass preparations, is generally round and about twice the size of a red blood corpuscle. There is, however, considerable variation in the size of the cell body. The most common form of nucleus is that of a partial coil or twist without separation into unconnected nuclear masses, although this apparent form of nucleus also occurs. The nuclear chromatin has a frequent tendency to a mural arrangement as described by Brinckerhoff and Tyzzer for rabbit's blood. This is especially noticeable where there are apparently several separate nuclear masses. The cytoplasm is most commonly homogeneous. Often, however, it has a granular appearance and occasionally contains a varying number of very fine reddish granules resembling the neutrophile granules of the polynuclear leucocyte in man's blood. The relative number of fine granular leucocytes varies in different specimens of dog's blood. In all specimens which we have examined, the homogeneous variety has far outnumbered the fine granular variety. This is somewhat at variance with the observations of Hirschfield,² who has found the

¹ See also Dawson (*loc. cit.*), who has given in some detail the morphology of the leucocytes in dog's blood.

² Virchow's Archives, Bd. 149.

granular variety more frequently. We have classified the homogeneous and fine granular variety together in our table of differential counts. The lymphocyte or small mononuclear cell comes next in point of number to the polynuclear. There is a great variation in the size of this cell as compared with the one of the preceding group, and there are many transitional forms between this and the large mononuclear. The typical cell of this variety is about the size of or slightly larger than a red blood corpuscle and contains a rounded nucleus which almost completely fills the cell. The nucleus is, as a rule, solid (Plate XIX., Fig. 2). Frequently, the chromatin is murally arranged in the form of a ring (Plate XIX., Fig. 4). Occasionally it has the appearance of segmentation (Plate XIX., Fig. 3). Forms are also sometimes seen with a double nucleus as if in the act of division, although we have not seen myotic figures. The large mononuclear leucocyte is more variable in number. In this class we have included only those leucocytes with a single round or bean-shaped nucleus and considerable cytoplasm (Plate XIX., Fig. 5). The nucleus is most commonly bean or kidney shaped and takes a lighter shade of stain than the small mononuclear. We have several times seen small granules, like neutrophile granules, in the cytoplasm of this form. The cytoplasm is, with these few exceptions, homogeneous or may show an indistinct network. We have seen forms with a very distinct network, but have ascribed this, possibly, to the method of fixing. Between this and the lymphocyte and also between the mononuclear form and the polynuclear variety there are transitional forms which it is difficult to classify. The eosinophile (Plate XIX., Fig. 8) is a corpuscle usually larger than the polynuclear form, with a nucleus that takes a lighter stain and is not so well differentiated. The granules, which are large, vary much in form and size as described by Hirschfeld (*loc. cit.*). They are usually round, but may be oval, bacillus shaped, or irregular in form. The number of granules varies also. Some cells are packed with granules, the granules having the appearance of crowding and partially hiding the nucleus, while other cells contain only a few. Between this cell and the polymorphonuclear leucocyte there are also a few

transitional forms both in respect to the size of the granules and the form of the nucleus. Mast cells were seen so infrequently, although very careful search was made for them, that they have not been included in the table of differential counts. This cell, when found, is about the size of the polymorphonuclear leucocyte. The nucleus is faint and poor in chromatin. The granules are fine and metachromatic (Plate XIX., Fig. 9).

TABLE OF DIFFERENTIAL COUNTS.

	Polymorpho-nuclear. Per cent.	Lymphocytes. Per cent.	Large mono-nuclear. Per cent.	Eosinophiles. Per cent.
Dog 1	67.7	24.7	5.3	2.1
" 2	57.1	29.3	8.8	4.6
" 3	64.6	25.1	9.0	1.1
" 4	74.5	9.7	9.7	1.4
" 5	87.5	3.7	7.7	1.0
" 6	64.5	21.3	6.8	7.2
" 7	67.0	16.5	13.2	3.0
" 8	60.0	28.3	4.2	6.2
" 9	66.6	23.0	8.0	2.2
" 10	69.8	16.5	5.1	8.4
" 11	60.1	22.8	3.7	15.2
" 12	54.3	35.3	3.9	4.9
" 13	66.2	21.8	4.8	6.9
" 14	73.0	14.6	7.2	5.1
" 15	63.0	21.2	8.4	6.7
" 16	66.9	19.8	7.7	5.4
" 17	59.8	35.0	4.2	0.8
" 18	73.1	15.9	6.0	5.1
" 19	61.7	28.3	7.0	2.7
" 20	54.9	26.5	4.9	13.6
Average	65.7	21.0	6.8	5.3

The maximal number of red corpuscles per cubic millimeter of blood was 8,030,000; the minimal number was 4,225,000. The maximal leucocyte count was 14,375; the minimal was 7,200. The average number of reds was 6,206,000 and of leucocytes 9,526 per cubic millimeter.

The following results of differential counts have been obtained:

In ten dogs, by Dawson (*loc. cit.*) :

Polymorphonuclear leucocytes	.62.4-65	per cent	average	64.56	per cent.
Lymphocytes	11.2-31.6	"	"	22.17	"
Oxyphilic leucocytes	2.6-21.0	"	"	8.85	"
Other forms	1.2-9.4	"	"	4.42	"

Tallqvist and Willebrand (*loc. cit.*) have tabulated differential counts in fifteen dogs as follows:

Polymorphonuclear leucocytes	.68.4-75.6	per cent	average	70-80	per cent.
Lymphocytes	4.2-10.8	"	"	5-10	"
Oxyphiles	0.2-6.6	"	"	4-8	"
Other forms	9.6-17.4	"	"	10-15	"

SUMMARY.—I. There are five distinct types of leucocytes in circulating dog's blood. These are: a small mononuclear leucocyte, a large mononuclear form, a polymorphonuclear form, usually non-granular but occasionally with fine neutrophile granules, and eosinophiles with coarse round or oval granules, and a mast cell with fine metachromatic granules.

II. The average percentage of the polymorphonuclear form is sixty-five and seven-tenths; of the small mononuclear, twenty-one; of the large mononuclear, six and eight-tenths; of the eosinophile, five and three-tenths. The occurrence of the mast cell is rare.

III. The percentage number of the polymorphonuclear form is subject to the least variation and that of the eosinophile to the most variation.

IV. In the few cases of high polymorphonuclear counts, the number of the lymphocytes was correspondingly de-

creased. On the other hand, where the eosinophile percentage was high, the percentage of other polymorphonuclear forms was low.

EXPLANATION OF PLATE XIX.

- Figure 1. Red corpuscles for comparison of size.
Figure 2. Lymphocyte or small mononuclear leucocyte with even distribution of chromatin.
Figure 3. Lymphocyte with segmental arrangement of chromatin.
Figure 4. Lymphocyte with mural arrangement of chromatin, giving appearance of a ring.
Figure 5. Large mononuclear form with bean-shaped nucleus poor in chromatin.
Figure 6. Polymorphonuclear form without granules.
Figure 7. Polymorphonuclear form with fine granules.
Figure 8. Eosinophile; nucleus poor in chromatin.
Figure 9. Mast cell; nucleus barely visible.



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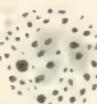
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CAT'S BLOOD

DIFFERENTIAL COUNTS OF THE LEUCOCYTES

F. C. BUSCH, M.D.

AND

CHARLES VAN BERGEN, M.D.

(From the Physiological Laboratory, University of Buffalo, Medical Department)

CAT'S BLOOD — DIFFERENTIAL COUNTS OF THE LEUCOCYTES.

F. C. BUSCH, M.D., AND CHARLES VAN BERGEN, M.D.

(*From the Physiological Laboratory, University of Buffalo, Medical Department.*)

Differential counts of the leucocytes in the blood of twenty normal cats were made to determine, if possible, a normal standard for this animal. Counts of the red and white corpuscles were also made. The staining methods upon which the percentages in the accompanying table are based are those of Leishman and Wright's modification of the same. In order to check results, smears were also stained with Ehrlich's triacid mixture, with methylene blue, with polychrome methylene blue, and with Dahlia. Blood was taken twelve hours or longer after feeding.

Morphology and staining reactions of the various leucocytes.
—The leucocytes of cat's blood may be divided, according to the form of the nucleus, into polymorphonuclear and mononuclear cells.

The polymorphonuclear may be sub-divided into granular and non-granular forms. The granular forms are distinguishable into those with large coarse granules, those with medium coarse granules, and those with fine granules. The fine granular forms are comparatively few and probably belong in the same class with the non-granular polymorphonuclear form which is the most frequent in the cat's blood.

The mononuclear forms may be differentiated into a small mononuclear (lymphocyte) and a large mononuclear. The large mononuclear may be further differentiated, according to the nucleus, into one with a bean or kidney shaped nucleus and one with a spherical nucleus.

The non-granular polymorphonuclear.—This form varies in size from a cell of a diameter only slightly greater than that of a red blood corpuscle to one of three or four times

that length. The cytoplasm is apparently homogeneous, taking a very faint blue or pink hue. The nucleus is polymorphous, having the appearance of a twist or knot, and with Wright's method stains a lilac shade. It corresponds in size and appearance to the polymorphonuclear cell of dog's blood.

The fine granular polymorphonuclear. — This cell is similar to the non-granular form, except that the cytoplasm contains a variable number of very fine granules having a faint affinity for eosin. These granules may be few and faintly stained, or the cytoplasm may be packed with granules taking quite a definite dark red stain. Other cells are seen with merely a granular appearance of the cytoplasm, but no definite granules. They are probably to be classed with the non-granular polymorphonuclear cells.

Coarse granular forms, oxyphile cells.¹ — These cells show a great variety in size and in the number, size, and form of the granules. There are two extremes with numbers of intermediate forms, which has made it difficult to classify them separately. We have, however, in our differential counts, under the heading of coarse granular oxyphile cells, differentiated two forms according to the size and shape of the granules. The granules all stain more or less intensely with eosin and vary in shape from spherical to that of rods with round ends. Occasionally a cell is seen as large as the large mononuclear forms, with long, narrow, rod-like granules having the appearance of bacilli. These cells frequently appear as a nucleus, with a number of free rods about it as if the cell body had burst and discharged its contents. The majority of the coarse granular oxyphiles are of about the same size and shape of granules as those found in the dog. There are cells, however, which are but little larger than a lymphocyte, where the granules are smaller and closely packed. These may possibly correspond to the cells which Hirschfeld²

¹ Classification of Kanthack and Hardy. *Journal of Physiology*, xvii, p. 81.

² H. Hirschfeld. *Arch. f. Path. Anat. u. Physiol.*, Bd. 149, Hft. 1, July 5, 1897.

describes as neutrophiles, because of their tinctorial qualities with Ehrlich's triacid mixture.

The nucleus, as a rule, is of the same form as that of the other polymorphonuclear cells. In the larger granular cells the nucleus often consists of two apparently unconnected bodies situated at opposite poles of the cell. The nucleus stains less intensely than that of the non-granular polymorphonuclear cell, and takes more of a blue shade. Mast cells were only occasionally seen in the blood of cats which we examined.

The mononuclear forms.—The small mononuclear or lymphocyte is slightly larger than a red blood corpuscle, and consists of a round nucleus surrounded by a narrow rim of cytoplasm. The nucleus stains a dark lilac, and the cytoplasm a faint blue. The chromatin has in most cases a typical mural arrangement. Frequently cells are seen with a nucleus apparently undergoing division.

The large mononuclear leucocyte has a diameter from two to three times that of the small mononuclear form.

The cytoplasm is relatively greater in proportion to the nucleus than in the lymphocyte. The nucleus may be either circular or indented. There is a tendency toward mural arrangement of chromatin. The nucleus takes a lilac stain; the cytoplasm a faint blue. The nucleus does not stain so deeply, however, as does that of the small mononuclear form, while the cytoplasm stains somewhat more deeply.

TABLE OF DIFFERENTIAL COUNTS.

NUMBER OF CAT.	POLYMORPHONUCLEAR CELLS, PER CENT.				MONONUCLEAR CELLS, PER CENT.		
	Coarse granular.		Fine granular.	Non- granular.	Large.	Small.	Mast cells.
	Large Oxy- philes.	Medium Oxy- philes.	Oxy- philes.				
I.....	1.40	3.35	2.24	56.84	7.28	28.89	0.00
II.....	0.63	5.00	1.60	50.00	6.50	36.27	0.00
III.....	3.96	5.94	2.80	47.52	10.62	28.98	0.18
IV.....	1.00	2.34	2.52	49.86	9.36	34.92	0.00
V.....	1.96	7.84	2.62	49.54	8.82	29.22	0.00
VI.....	0.30	6.00	1.80	58.20	5.30	28.30	0.10
VII.....	1.20	2.80	1.80	50.60	4.20	39.40	0.00
VIII.....	0.40	3.10	0.40	64.00	1.70	30.40	0.00
XI.....	0.25	2.25	2.50	65.25	5.25	24.25	0.25
XII.....	0.44	2.49	0.44	53.59	4.84	38.20	0.00
XIII.....	2.10	8.90	1.10	44.10	3.70	41.	0.00
XIV.....	1.20	5.30	2.50	53.50	4.60	32.90	0.00
XV.....	0.20	2.80	0.00	66.00	2.40	28.60	0.00
XVI.....	0.30	5.70	0.60	60.20	3.00	30.20	0.00
XVIII.....	0.20	5.30	0.70	59.50	5.80	28.50	0.00
XIX.....	0.68	3.82	0.30	53.90	3.20	38.10	0.00
XX.....	0.93	5.67	1.70	55.00	3.40	33.30	0.00
XXI.....	0.561	2.992	0.561	48.246	3.553	43.90	0.187
XXII.....	0.200	3.100	0.300	46.70	1.8	47.90	0.00
XXIII.....	0.300	2.8	0.600	49.30	2.6	44.40	0.00
Average.....	0.90555	4.3596	1.36405	54.1523	4.89615	34.3865	0.03585

The minimum number of red corpuscles per cubic millimeter of blood was 4,805,000; the maximum was 7,610,000; the average was 6,609,000.

The minimum leucocyte count was 7,219; the maximum, 19,000; the average, 13,331.

SUMMARY.

1. In circulating cat's blood seven varieties of leucocytes may be distinguished. These may be divided into polynuclear forms and mononuclear forms, also into granular and nongranular forms. The latter are the more numerous.

2. There are three polymorphonuclear forms with oxyphile granules: a large coarse granular form with rod-shaped granules (Fig. 7), a smaller, coarse granular form with round granules (Fig. 6), and a fine granular form (Fig. 5). Between these three there are a number of transition forms.

3. The mononuclear cells are of two kinds, a large and a small, the former with considerable cytoplasm and with either a bean-shaped or spherical nucleus (Fig. 3), the latter with a spherical nucleus and a narrow rim of cytoplasm (Fig. 2).

4. Mast cells may be present, but in small numbers.

5. The approximate percentages of the various forms is as follows: Polymorphonuclear without granules, 54.1523 (Fig. 4); with large coarse oxyphile granules, 0.90555; with medium coarse oxyphile granules, 4.3596; with fine oxyphile granules, 1.36405; large mononuclear forms, 4.89165; small mononuclear forms, 34.3865; mast cells, 0.03585.

EXPLANATION OF PLATE III.

FIG. 1. — Red blood corpuscles for comparison.

FIG. 2. — Small mononuclear leucocyte.

FIG. 3. — Large mononuclear leucocyte.

FIG. 4. — Nongranular polymorphonuclear leucocyte.

FIG. 5. — Fine granular oxyphile.

FIG. 6. — Medium coarse granular oxyphile.

FIG. 7. — Large coarse granular oxyphile.



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THE FREQUENCY OF TRICHINOSIS IN THE UNITED STATES

HERBERT U. WILLIAMS, M.D.

(Professor of Pathology, Medical Department, University of Buffalo)

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(*Professor of Pathology, Medical Department, University of Buffalo.*)

Although numerous epidemics and sporadic cases of trichinosis have been recognized in the United States, the impression still seems to be prevalent that it is a rather uncommon disease.

The frequency of trichinosis in hogs in this country has been determined, from the immense number of examinations of pork made for commercial reasons, to be about two per cent.¹⁶⁻²¹ The studies described in the present paper were suggested by the apparent lack of any such systematic researches upon the frequency of trichinosis in human subjects, either here or abroad. The references which I have been able to find bearing upon this question, are, at all events, not very numerous, though probably many have escaped me, as I have only been able to examine a small portion of the enormous literature on trichinosis.

The statement that one to two per cent. of dissecting-room subjects contain trichinæ occurs in many books and articles, usually, however, without naming authorities. In 1855 Zenker²⁷ discovered four cases of trichinosis in one hundred and thirty-six autopsies at Dresden. According to Fiedler,⁷ writing in 1866, encapsulated trichinæ were found at two to two and one-half per cent. of the autopsies in the Dresden hospitals. The parasites were usually present in small numbers. Leuckart¹³ stated in 1866 that in Berlin and Dresden three per cent. of all subjects contained trichinæ. The following figures are quoted by Mosler and Peiper¹⁶: Müller found in Dresden during the years 1852-1862, in nineteen hundred and thirty-nine autopsies, nineteen cases of trichinosis, *i.e.*, .98 per cent.; in Erlangen the same writer found during the years 1862-1873, in eight hundred and twelve autopsies, two cases, *i.e.*, .25 per cent.; Gribbohm in Kiel,

1872-1877, in nine hundred and seventy-two autopsies, one case, *i.e.*, .1 per cent.; Sivers found in the same place, 1877-1887, in two thousand six hundred and twenty-nine autopsies, two cases, *i.e.*, .08 per cent.; Roth in Basel found, 1872-1880, in nineteen hundred and fourteen autopsies, two cases, *i.e.*, .1 per cent.

The above figures have been interpreted by some as indicating that a diminution in the frequency of this disease has taken place in Germany since the introduction of the microscopic examination of pork.

Wagner of Leipzig is said by Heller⁹ to have found trichinæ once in every thirty to forty bodies; and again he is quoted⁵ as having made a verbal statement to the effect that he met with trichinosed corpses in the proportion of four to six per one hundred. In Scotland one to two per cent. of the dead bodies examined during the five years preceding 1860 are said by Turner²⁴ to have contained trichinæ. Scheiber²² in Bukarest stated in 1871 that in Roumania about one body in two hundred contained trichinæ. In St. Petersburg Rudnew found trichinæ three times among one hundred and fifty dissections. (Cited by Heller⁹.)

According to Lancereaux¹⁰ and Blanchard² trichinosis in man is almost unknown in France. Delpach⁵ remarked in 1866 that Cornil and Ranvier, while engaged in researches on the muscular system, examined a considerable number of subjects, but never encountered these parasites, and that they had only been observed at autopsies three times in twenty years. The few cases that have been described in France are discussed by Delpech,⁵ Chatin,⁴ and Blanchard.²

Concerning the frequency of trichinosis in the United States the following references have come to my notice:

Glazier,⁸ in a report made to the Treasury Department of the United States in 1881, quotes from letters received from various pathologists and anatomists in the United States, but no exact statements as to the frequency of this disease were received. Kerber, in San Francisco, had made thirteen consecutive examinations (presumably microscopic) of subjects and found no trichinæ. Dr. Leidy,¹² the distinguished discov-

erer of the fact that trichinæ occur in the hog, wrote that he had repeatedly seen trichinæ in subjects in the dissecting room at the University of Pennsylvania, but that no record of them had been made. Glazier also gives descriptions of various outbreaks of the disease in the United States. Salmon,²¹ in the First Annual Report of the Bureau of Animal Industry of the United States, quotes letters from various boards of health relative to the frequency of trichinosis in general and gives accounts of several outbreaks of the disease.

Whelpley,²⁶ in St. Louis in 1891, examined with the microscope specimens from twenty cadavers in the dissecting room and found one case of trichinosis.

Thornbury,²³ in Buffalo in 1897, found three cases of trichinosis in twenty-one dissecting-room subjects examined microscopically.

Osler¹⁷ states that his notes show that in one thousand consecutive autopsies trichinæ were present in six instances.

In the Index of Post-mortems made at the Montreal General Hospital,¹⁵ 1883-1895, it appears that in nine hundred and nineteen post-mortems trichinosis was discovered two times.

In eleven hundred and three autopsies at the Boston City Hospital trichinosis was encountered two times. No especial search was made for the parasites at these autopsies. I am indebted to a personal communication from Dr. Mallory for these figures.

In none of the above observations is it specified that systematic microscopic examinations of all cadavers were made except in the instances which I have expressly mentioned. The most important of the foregoing statistics are given below in tabular form:

Reported by	Place	Date	Cases Examined	Positive Cases	Per Cent.
Zenker.....	Dresden.....	1855	136	4	2.94
Fiedler	Dresden.....	1866	.....	.....	2. to 2.5
Leuckart	Berlin Dresden }	1866	.....	.....	3.00
Müller	Dresden	1852-1862	1,939	19	0.98
Müller	Erlangen.....	1862-1873	812	2	0.25
Gribbohm	Kiel.....	1872-1877	972	1	0.10
Sivers.....	Kiel.....	1877-1887	2,629	2	0.08
Roth	Basel	1872-1880	1,914	2	0.10
Wagner.....	Leipzig.....	186-	.....	.....	3.00
Scheiber.....	Bukarest.....	1871	.....	.....	0.50
Rudnew.....	St. Petersburg.....	.....	150	3	2.00
Blanchard et al.	France .....	.....	.....	.....	0.00
Turner	Scotland.....	1855-1859	.....	.....	1. to 2.
Osler	Baltimore.....	1899	1,000	6	0.60
Johnston et al..	Montreal.....	1883-1895	919	2	0.22
Mallory	Boston.....	1901	1,103	2	0.18

Packard¹⁹ was able to find in July, 1897, that between 1864 and 1897 three hundred and fifty-seven cases of trichinosis in man were known to have occurred in the United States and Canada. While, according to a communication from Stiles to Osler¹⁷ in February, 1898, about nine hundred cases had been reported from the United States up to that date.

The studies described here were begun in 1894. I have been encouraged to continue them by the paper of Osler¹⁸ on "Sporadic Trichinosis," and by Brown's³ observations on the increase of the eosinophilic leucocytes in trichinosis, together with the numerous articles which have since appeared confirming Brown's statements. All these seem to show that cases of trichinosis occur not infrequently. My own work

has consisted in the application of the procedure used in the microscopic inspection of pork to human subjects. The proportion of positive results obtained was much larger than was anticipated at the outset. *Five hundred and five cadavers were examined, and trichine were found present in twenty-seven, or 5.34 per cent.* The subjects studied were not selected as being more likely to be infected with trichinosis than any others, but were taken at random. They came from points as far apart as Buffalo, Baltimore, and Denver, from all of which localities cases of trichinosis were discovered. The infections were never very recent, as was evinced by the encapsulation, and frequently calcification, of the parasites. All the subjects died from other causes than trichinosis. In one case only one, in another only two trichinae were found after the most searching examination, so that in these two instances the infection was probably of a very mild degree. In other cases the diaphragm was riddled with the parasites. The infections were, therefore, of all degrees of severity. (See Plate VI., Fig. 1.)

Method of Examination.—The muscles selected in the earlier examinations (ninety-two) were the diaphragm, the sterno-cleido-mastoid, and the psoas magnus. In the later examinations (three hundred and sixty-nine) the diaphragm, sterno-cleido-mastoid, one intercostal, the rectus abdominis, and the psoas magnus were the ones chosen. In a few instances (forty-four) parts of only two muscles or of the diaphragm alone were secured. As it usually was not permitted to make an incision high enough to reach the tongue or the muscles of the larynx these could not be systematically examined. As far as was possible, the samples were taken near the tendons. They were usually about three centimetres long, and one to two centimetres in width and thickness; but were often larger. It was not attempted to keep records of the frequency with which the different muscles were affected. This would have increased the labor of the research so greatly as to be entirely beyond the resources at my command. But it was observed that the diaphragm was most often and most extensively affected. The specimens were examined immedi-

ately when possible. If the examination was delayed they were preserved in cold storage or with a weak solution of formaldehyde. The latter was especially useful when the samples were collected in other cities. (For these, also, I am greatly indebted to various friends who assisted me in securing them.) Formaldehyde serves the purpose exceedingly well, as the worms appear very distinct when thus preserved, but it makes the muscle tough and somewhat difficult to compress. Twenty to forty pieces of muscle were snipped off with scissors, compressed in the usual manner between plates of glass, and studied under the microscope with a low power. From three-quarters of an hour to one and one-half hours were spent in studying each case. The bulk of the examinations were made by medical students and by the laboratory helpers, who were specially instructed for the work. I can testify to their fidelity and to the minute care with which each preparation was scrutinized.

In two cases only, which were autopsies in the writer's service, the calcified capsules were observed with the unaided eye before the microscopic diagnosis was made. The material from the first two positive cases was unfortunately lost several years ago. I have submitted slides from the other twenty-five cases to Dr. Stiles and Dr. Hassall of the Bureau of Animal Industry, who kindly examined them, and who agreed with me that there was no reasonable doubt that the parasites which they contained were trichinæ. (Dr. Stiles prefers to call this worm *Trichinella spiralis*.*)

* Dr. Stiles has recently sent me the following note concerning the name of this worm:

"The name *Trichina spiralis*, which is almost universally adopted in medical literature, is not available as a technical name for this parasite. Owen in 1835 proposed the generic name *Trichina*, but he overlooked the fact that this name was already pre-occupied in zoölogy for a genus of Diptera proposed in 1830; hence, by the rule of homonyms adopted by zoölogists, Owen's name cannot be retained for worms. On this account Railliet substituted the name *Trichinella* for *Trichina* Owen, and this substitution is now being adopted by specialists in medical zoölogy. It may also be mentioned that the term *Trichina* was further used by Kirby in 1837 for a genus of beetles. The continued use of the same technical name for three distinct zoölogical genera would naturally result in considerable confusion, and since it is the prerogative of zoölogists rather than physicians to determine the correct name of an animal, it is not only a practical measure, but also a matter of professional courtesy for physicians to adopt the name selected by zoölogists."

Character of the Subjects.—All the bodies were those of adults more than fourteen years old. They were in most cases, but not always, from the humbler walks in life. The ages of the positive cases were as follows: 19, 26, 33, 35, 38, 40, 45, 46, 47, 47, 52, 58, 58, 58, 60, 62, 65, 65, 66, 70, 71, 71, 73, 78, 78, with two unknown.

Twenty-one of the positive cases were males, five females, one unknown. The subjects were of various nationalities (places of birth), which are shown in the following table:

	Positive.	Negative.	Total.	Per cent. of + cases in each nationality.
U.S. white	6	201	207	2.89
U.S. colored	5	65	70	7.14
British and Irish.....	5	57	62	8.06
Canadian	2	10	12	16.66
German	6	43	49	12.24
Italian	2	10	12	16.66
Other nationalities	0	27	27	0.00
Unknown.....	1	65	66	1.51
	27	478	505	5.34

This table seems to require very little explanation or comment. As was to be expected, the proportion is large in subjects of German birth, though not always in excess of the others, as I anticipated. On the other hand, a larger percentage occurred in whites of American birth than I should have imagined would exist in those of any nationality whatever. The question naturally arises whether some of the American whites may not have been of German parentage, and have continued in the ancestral practice of eating uncooked pork. In answer to this it may be said that none of the whites of American birth were known to have had German parents or had distinctly German names. In the subjects born in Ger-

many or other foreign countries, there is no way of ascertaining whether the disease was acquired in the fatherland or in the United States. In securing the histories, the length of time which the patient had been in this country was determined whenever possible. Considering that so much has been said in the American press of the German habit of eating uncooked pork, it is but fair to state that Americans are not entirely beyond criticism in this respect. At least, I am credibly informed that farmers, both in New York State and in the southern parts of the United States, occasionally take a piece of pork from the barrel and eat it without further preparation; also that they sometimes eat, without cooking, slices of ham of their own curing. I do not, however, imagine that the custom of eating uncooked pork is common here to anything like the degree that it is in Germany. The large percentage found in the colored race of the United States I suppose to be owing to carelessness in preparing food and in eating, though I would speak with caution on this point, from lack of knowledge of their habits. I am unable to account for the large percentage among British subjects beyond remarking that a number of them were insane cases, as will be seen later on.

The following table represents the localities in the United States in which the post-mortems were made:

CITIES.	Positive.	Negative.	Total.	Per cent.
Buffalo	12	293	305	3.93
— N. Y.	9	48	57	15.78
Philadelphia.....	0	7	7	0.00
Baltimore	5	121	126	3.96
Denver	1	9	10	10.00
	27	478	505	5.34

I do not attach much significance to the figures shown in this table. Knowing how frequently — one might probably

with safety say how usually—an ordinary adult American will have lived in more than one place during his lifetime, it would not be fair to connect the presence of trichinæ in his muscles with the place where he happened to die. The wandering character of many hospital and almshouse cases is well known. I have not named the place indicated by dashes, from which the extraordinary number of nearly sixteen per cent. of positive cases was obtained, for the reason that it might seem to reflect upon the locality, which would be unjust. My own tendency is to regard this percentage as fortuitous. I may say that the material was secured from a large institution in New York State outside of Buffalo. I am informed that pork does not form a large part of the dietary at this institution. It was, however, stated that their pork came from pigs raised on the premises, also that the pigs were decimated by a disease diagnosed by a veterinarian as hog-cholera, just before the collection of samples for this work was begun.

In answer to further inquiries, I received the following reply:

The percentage of cases is surprising, but that is not conclusive proof that they originated here. Many of the patients had been in county (alms) houses for many years before they were sent here, notoriously places where people are carelessly fed, though I think recent conditions are better than those formerly prevailing. Others came from State institutions where they had been for some years. One case was here but a week or ten days. Only one case came from home and remained here until death, and with her (granting for equal periods that the likelihood is the same outside as here for contracting the disease) the chances are forty to one that she contracted the disease at home, being here but two years out of the eighty of her life. Then again we are careful in our methods of cooking, and contrast such care with the conditions existing in an Irish hovel.

Whether or not a local epidemic of trichinosis was encountered must remain a matter of opinion. The foregoing constitutes all the evidence available, except the condition of the parasites found in these cases. The trichinæ were invariably encapsulated. Frequently they were calcified and even disintegrated, so that the subjects containing them probably acquired the infection before entering the institution.

Another fact worthy of comment is that there was an undue proportion of positive cases among the insane. About one-third of all the positive cases occurred among insane persons. In eighty-two autopsies on subjects who had been insane, trichinosis was found ten times, or about twelve per cent. As the number of cases examined was not large, this percentage may be accidental. At all events, it appears to me not difficult of explanation, as most insane cases will pass some time at home in a condition of more or less disturbed mental balance before being committed to hospitals. During this period, owing to carelessness in the preparation and selection of food, infection with trichinae would be more likely to occur than in healthy persons. This is especially true of paresis.

The clinical histories which I have been able to secure have usually been very meagre and unsatisfactory. In a few instances we get some account of an illness which might have been an attack of trichinosis, notably Cases V., XVII., XIX., XXII., XXIV. I have endeavored in connection with the histories to characterize the extent of infection. This, in the absence of any means of measuring it exactly, I have called mild, moderate, or severe, according to whether the number of worms found in sections was very small, moderate, or very large. I am well aware that this method cannot be exact, on account of the uneven distribution of the parasites through the muscles. Also, others might differ from me as to what constituted a mild or a severe infection. As I have classified them, nine cases were severe, nine were moderate, and nine were mild infections.

Case I.—J. G. Male; born in Germany, age 73, mechanic; Erie County Hospital, Buffalo, Sept. 5, 1894. The history of the case related wholly to his last illness and was unimportant. Autopsy Nov. 15, 1894. Anatomical diagnosis: Carcinoma of the stomach. The calcified trichinae were numerous and plainly visible. This was one of the two cases in which the diagnosis of trichinosis was made without the aid of microscopic examination. Degree of infection *severe*.

Case II.—J. K. Male; born in Germany; age 78; Erie County Hospital, Dec. 19, 1894. No history obtainable. Examination of patient not important. Died Dec. 19, 1894. Anatomical diagnosis: Broncho-pneu-

monia. Degree of infection with trichinæ *moderate*. The worms were encapsulated.

Case III. — H. K. M. Male; born in Scotland; age 70; a pauper, admitted Erie County Almshouse, March, 1893. Denied having had any previous illness. Has gradually lost the use of his hands and arms; can touch the top of his head with his hands, but is unable to feed himself. When he gets off his feet complains of pain in the soles of his feet and toes, and cannot walk. Has had no vomiting; patellar reflex lost; pupils react to light; sensation everywhere present, but delayed; muscular power in the hands slight; history otherwise unimportant. Died April 8, 1898. Anatomical diagnosis: Chronic interstitial nephritis; brain and spinal cord not examined. Infection with trichinosis of *severe* degree. This was the second case in which the calcified capsules were recognized with the unaided eye.

Case IV. — C. LeR. Male; born in Italy; age 38; stone-mason; Erie County Hospital, March 18, 1898. Had two years before undergone an operation for appendicitis in the Buffalo Hospital of the Sisters of Charity. No history of other previous disease. Complained of nausea, and of constant pain in the epigastric region; otherwise, present history not important. Died May 5, 1898. Anatomical diagnosis: Perforating ulcer of the jejunum, fibrino-purulent peritonitis, suppurative lymphadenitis of lumbar nodes, post-cæcal abscess. Infection with trichinæ of *severe* degree. Worms encapsulated; not much calcification.

Case V. — J. G. Male; born in the United States; age 47; umbrella-maker; Erie County Hospital, Nov. 21, 1898. As a child he had scarlet fever and measles. Twenty-seven years ago he was sick with rheumatism all over his body for one winter. He had gonorrhœa and a chancroid twenty-two years ago. About twelve years ago he first felt pain over the heart, which was with him more or less for ten years. He was a steady drinker and smoker. His last illness began six weeks before his admission, when he began to lose his appetite, and often had chilly feelings followed by burning sensations. Three weeks ago he noticed a difficulty in breathing on lying down or on going upstairs. He had pains over the heart occasionally. His temperature chart showed through his whole illness a pretty regular evening rise of temperature to 100° - 102° F., rarely to 103° F. Urine not remarkable till shortly before his death, when albumen appeared. Jan. 14, 1899, red blood-corpuscles, 5,300,000; leucocytes, 9,375; hemoglobin, 62 per cent.; sp. g., 1,046. No malarial parasites. March 5, red blood-corpuscles, 3,500,000; leucocytes, 7,800. Died March 20, 1899. Anatomical diagnosis: Ulcerative and verrucose endocarditis, anemic infarcts of spleen. Degree of infection with trichinosis *severe*. The worms were encapsulated, and the capsules calcified. It seems impossible to determine whether the disease which he had twenty-seven years before death was really rheumatism or an attack of acute trichinosis.

Case VI. — F. C. Female; born in England; age 78; Home for the Friendless, Buffalo. From her family no information of any interest was

secured except that the patient had habitually eaten pork. It was asserted that her health had always been good. Her surroundings had been squalid. After her entrance at the Home, no complaint was made of rheumatic or muscular pains. The history secured was without interest. Died Dec. 9, 1899. Anatomical diagnosis: Broncho-pneumonia, fatty degeneration of the heart, carcinoma of the rectum, metastases in the liver. Infection with trichinosis of *severe* degree. The worms were encapsulated, and the capsules calcified.

Case VII.—A. R. Male; born in the United States; colored. The body was that of a subject in the dissecting room in the University of Buffalo. No history whatever was obtainable beyond the fact that the man was a laborer who met his death by falling from a high building. The infection with trichinosis was the most *severe* I have encountered. The diaphragm was riddled with the calcified capsules. (See Plate VI., Fig. 1.)

Case VIII.—M. P. Male; born in the United States; age 60; Buffalo Hospital of the Sisters of Charity; March 20, 1900. No history obtained. Died March 21, 1900. Anatomical diagnosis: Acute pleuritis, fatty degeneration and dilatation of the heart. Trichinae encapsulated but not calcified. Degree of infection *moderate*.

Case IX.—A. T. Male; colored; born in the United States; age 35. Johns Hopkins Hospital, Baltimore. Teamster. From the detailed history of the case the following facts were selected: He had always lived in Baltimore County, had been much exposed to the cold and wet, had a hearty appetite and had eaten "much hog-meat and hard grub." No account was given of rheumatism, typhoid fever, or any gastro-intestinal disease. The latter part of his history tells of swelling of the feet, general edema, dyspnea, rapid pulse, and respiration. Autopsy Feb. 11, 1900. Anatomical diagnosis: Aortic aneurism, insufficiency of the aortic valves. Only two trichinae were found, although the material was imbedded in celloidin and many hundred sections were examined. The infection was classed as *mild*. The worms were encapsulated, and one of them partly disintegrated.

Case X.—J. S. Male; born in Newfoundland; ship carpenter; age 66; Johns Hopkins Hospital, Baltimore. The history gives no account of typhoid fever, rheumatism, or gastro-intestinal disorder. His last illness resulted from running a sliver into his hand. Diagnosis: General septicemia and pneumonia. Infection with trichinosis of *mild* degree. The worms were encapsulated and calcified.

Case XI.—P. P. Male; colored; born in the United States; age 65. Oyster-shucker; Johns Hopkins Hospital. The history states that his whole life was spent in Maryland, except three years, during which he was a soldier in the civil war. There was no account of rheumatism or typhoid fever. In his last illness he suffered from abdominal distension and tenderness, ascites, fever, weakness, and loss of appetite. Autopsy April 5, 1900: Tuberculous peritonitis. The infection with trichinosis was of extremely *mild* degree. Only one encapsulated worm was found. Several

hundred celloidin sections were examined without revealing any more parasites. Some miliary tubercles were seen in the intermuscular tissue of the diaphragm.

Case XII.—M. McJ. Female; born in the United States; age 46; Johns Hopkins Hospital, Baltimore. The patient entered the hospital when very ill, and died in twenty-four hours, before any satisfactory history could be secured. Autopsy May 1, 1900. Lobar pneumonia. The infection with trichinæ was of a *mild* degree. The worms were encapsulated and calcified.

Case XIII.—Male; born in the United States; age 58; book-keeper. He had been a moderate drinker. Was insane for two and one-half years before his entrance. He complained of severe headache following paralysis which ushered in insanity. This never left him. He was demented when admitted. Examination showed hyperesthetic areas over the skin, hesitating, tremulous speech, hemiplegia, and talipes equinus. No important changes in his condition occurred for some time. Then contractures of the left side began to develop. He was bed-ridden from the time he entered. Nothing further of note appeared till his death, April 4, 1900. Autopsy showed extensive cerebral softening. The worms were encapsulated and calcified. Degree of infection *mild*.

Case XIV.—Male; born in the United States; age 58; a butcher. The patient had been a veteran of the civil war, had been a hard drinker, and had had syphilis. Insanity began six months before his entrance. His history was uneventful otherwise up to the time of his death, which occurred suddenly during an attack of tonsillitis. Autopsy, May 5, 1900, showed embolism of the pulmonary artery. The trichinæ were encapsulated. Degree of infection *mild*.

Case XV.—Male; born in Ireland; age 71; laborer. The patient had been insane more than fifteen years before his entrance. He was then demented. He had no other illness or indisposition up to the time of his death, June 6, 1900. Anatomical diagnosis: Rupture of an aneurism of the abdominal aorta. The trichinæ were encapsulated and calcified. Degree of infection *severe*.

Case XVI.—The material came from a case diagnosed syphilitic cirrhosis of the liver. No other facts could be secured. The parasites were encapsulated and calcified to a slight extent. Degree of infection *severe*.

Case XVII.—R. T. Male; colored; born in the United States; age 40; coachman; Erie County Hospital, Buffalo, N.Y., Oct. 12, 1900. The patient stated on entering that he had some trouble with his right leg about one year ago. The leg and knee were painful. One arm was also painful. His statements were confused, and he was in a partly demented condition. His only complaint was of stiffness of his legs. The history otherwise was unimportant. He died Oct. 30, 1900. Anatomical diagnosis: Broncho-pneumonia, arterio-sclerosis, chronic interstitial nephritis. The parasites were encapsulated, and there was calcification about the capsules. Degree of infection *severe*.

Case XVIII. — Male; born in Canada; age 58; carpenter; Oct. 29, 1900. The patient had gonorrhea when a young man, and malaria on two occasions. He had suffered with asthma for fifteen years, and had had influenza several times. Otherwise his history related only to his last illness. Died Dec. 11, 1900. Anatomical diagnosis: Carcinoma of the stomach, metastases in the liver. The trichinæ were encapsulated and calcification had occurred about the capsules. Degree of infection *mild*.

Case XIX. — W. M. Male; colored; born in the United States; age 33; Johns Hopkins Hospital, Baltimore. The patient was born in Alabama. He gave no history of typhoid fever. When he was twenty-three years old he had rheumatism in the arms and legs, and was laid up eight months with it. This attack was said to have been without fever. He had had a good digestion and was a hearty eater. He had been a hard worker, having been working lately in water in a tunnel. His recent history told of cough, dyspnea, vomiting, edema, and rapid pulse. Death was sudden. Autopsy Oct. 21, 1900. Anatomical diagnosis: Arteriosclerosis, pericarditis, chronic interstitial nephritis. The infection with trichinæ was of *moderate* degree. The parasites were encapsulated.

Case XX. — Female; born in Germany; age 45; housewife. The patient had been in the United States twenty-eight years. She suffered from hyper-acute mania, and died of exhaustion after ten days. No important lesions were reported at the autopsy. The trichinæ were encapsulated but not calcified. Degree of infection *moderate*.

Case XXI. — Male; born in Ireland; age 47; laborer. The patient had lived in the United States twenty to thirty years. His habits had been good, otherwise no history of his early life was obtained. He had mild dementia. The further progress of the case was without interest. He died suddenly, July 26, 1900. The autopsy showed the coronary artery was nearly obliterated by an endarteritis. The trichinæ were encapsulated, and many were disintegrated; calcification was not marked. Degree of infection *moderate*.

Case XXII. — Male; born in the United States; age 19. The patient had been an epileptic from infancy, and had passed nearly all his life in institutions. He was not robust when admitted. He was demented, and filthy in his habits. During April, 1899, he had an attack of diarrhea, which became chronic, and was supposed to be due to intestinal tuberculosis. After a long time (how long not stated) the diarrhea abated. His general condition became slowly worse, however, and pulmonary tuberculosis was diagnosed. He died Aug. 29, 1900. Autopsy showed pulmonary tuberculosis, but no intestinal tuberculosis, and the intestines appeared normal. The trichinæ were encapsulated. Calcification was not present to a marked extent. Degree of infection *moderate*.

Case XXIII. — Female; born in Ireland; age 71; housewife. She had been fifty years in the United States. An examination of the blood at the time of her admission (June, 1899) showed red corpuscles

5,300,000; leucocytes 8,000; lymphocytes 12 per cent.; large mononuclears 7 per cent.; polynuclear neutrophiles 80 per cent.; eosinophiles 1 per cent.; hemoglobin 60 per cent. Diagnosis of senile dementia. Nothing of note occurred in her case, till she had an attack of dysentery, Sept. 23, 1900; of this she died. The autopsy showed no important lesions other than those of dysentery. The infection with trichinæ was of *moderate* degree. The parasites were encapsulated, and partly disintegrated.

Case XXIV.—Male; born in Germany; aged 62; carpenter. Had been twenty-four years in the United States. His case was diagnosed as terminal dementia, he had been insane more than fourteen years. March 23, 1900, he had an illness which was at first supposed to be typhoid fever, but which was afterwards regarded as intestinal auto-intoxication. There was an evening rise of temperature to from 101° F. to 103° F.; the morning temperature was normal. He was constipated, and complained only of headache and malaise. This illness lasted only a week. Ordinarily he was tidy, industrious, and agreeable. His death occurred suddenly, Sept. 22, 1900. Anatomical diagnosis: Arterio-sclerosis of the coronary artery, fibrous endocarditis, and pericarditis. The infection with trichinæ was of *moderate* degree. The worms were encapsulated.

Case XXV.—Mrs. F. Female; born in Germany; age 26; Arapahoe County Hospital, Denver, Col. Had been in the United States since 1881; had been in Colorado since 1900. No further history obtainable. Anatomical diagnosis: Pulmonary tuberculosis, chronic endocarditis, cardiac dilatation. Trichinæ encapsulated. Degree of infection *moderate*.

Case XXVI.—A. S. Male; born in Germany; age 65; Buffalo, N.Y., July 4, 1900; merchant. Had been in the United States many years. No history of importance was obtained. Autopsy showed cirrhosis carcinomatosa. The trichinæ were encapsulated, calcified, and much disintegrated. Degree of infection *mild*.

Case XXVII.—Male; born in Italy; age 52; laborer. He had been in the United States seven years. No history was obtained of his previous life. The diagnosis of transverse myelitis was made. He was helpless and bed-ridden. He died June 1, 1900. Autopsy showed also endocarditis, myocarditis, and cirrhosis of the liver. The infection with trichinæ was of *mild* degree. The worms were encapsulated and much disorganized. There was unusually marked fatty infiltration about the capsules.

Pathological Histology.

The material which I have secured from human cases has given me abundant opportunities for studying the histology of the lesions of old trichinosis. Various other interesting affections of the muscles were encountered, which it is not

the province of this paper to discuss. It may be remarked, however, that no other disease due to animal parasites was observed. In particular, we were on the lookout for the protozoön parasites called Rainey's or Miescher's tubes, but they were in no case seen. This is of some interest in view of the fact that they are common in hogs, and are often found in hog's muscle that also contains trichinæ.

Leuckart, Virchow, and many others discussed the lesions of late trichinosis so thoroughly, more than thirty years ago, that little remains to be said. In 1892 R. Langerhans¹¹ described alterations in the capsules of a case in which the infection with trichinæ had probably occurred thirty-one years previously. Studies on this case showed that the parasites might disintegrate and empty capsules remain, or that the capsules, empty or still containing parasites, might be invaded by granulation tissue, with new-formed capillaries, and become filled with fibrous tissue. These changes had in part been described by Leuckart. Langerhans also found that fat-cells might appear in the new-formed tissue inside of otherwise empty capsules. Finally, he saw the capsule itself become split into lamellæ by the growth of young connective tissue and apparently become destroyed. All of these changes, except the last, I believe I have seen in two of my cases (XXVI. and XXVII.). See Fig. 2. Several times concentrically striated bodies were seen inside the capsules, resembling *corpora amylacea*, from the size of a leucocyte to several times these dimensions. Langerhans appears to have described the same. The presence of two or more trichinae in one capsule was not observed, although, as is well-known, that frequently occurs in the hog.

Examination for Eosinophilic Cells.

It remained only to investigate these lesions of old trichinosis with some of the newer staining methods. Perhaps the most interesting field lay in the examination of the tissues about the capsules for eosinophilic cells, since the familiar studies of Brown³ and others have shown that in acute trichinosis eosinophiles are abundant in the vicinity of the para-

sites. For this particular work my material was not very favorable, as, for reasons already given, most of it was preserved in formaldehyde. Some of the specimens had also been on hand a long time. In a few cases the muscle had been kept in alcohol, and in two instances satisfactory fixation in Zenker's fluid was secured. In all, the tissue seemed fairly promising in eight cases. Paraffin imbedding was used. The sections were stained in the Ehrlich triple stain, eosin and methylene-blue, or hematoxylin and eosin. In no case was an eosinophilic cell observed anywhere in the sections. I do not, however, consider my work in this respect final, and hope to confirm it with more favorable material.

Examination for Mast-Cells.

Mast-cells were seldom seen in the tissue between the muscle-fibres. A few times a single mast-cell was seen lying near a capsule. Evidently these cells have no particular affinity for the encapsulated trichinæ. Plasma-cells were sometimes seen about and also within the capsule, though not frequently. There was considerable variability in the number of cells about the capsules, but it was not usually large. Besides the plasma-cells, there were cells with elongated nuclei presumably connective tissue cells, large cells probably endothelial in origin, and cells with oval nuclei resembling those of the muscle-fibres.

Examination for Elastic Fibres.

The capsules which surround the trichinæ are dense fibrous structures, staining red in acid fuchsin. Elastic fibres may occur outside of and about the capsules. From twenty-three of the twenty-seven cases, satisfactory preparations were secured, using Weigert's stain. In about one-third of them elastic fibres were present in greater abundance about some of the capsules than in the neighboring structures. This increase did not appear about all of the capsules. It was difficult to determine how far the increase might be only apparent and due to atrophy of muscle-fibres with condensation of all the connective tissues. In some cases, certainly, the

amount of elastic tissue was large enough to justify the opinion that it was chiefly of new formation. It is conceivable that the presence of a quantity of elastic tissue about the calcified capsules might serve to diminish the friction, and therefore the pain caused by them in movements of the muscles.

The muscle of three trichinous hogs was also studied in sections, using Weigert's stain for elastic tissue, but no increase of the elastic fibres worthy of note was seen. This result was to be expected, for the infections were probably recent as compared with the human cases.

Summary.

1. Samples of muscles secured at five hundred and five unselected autopsies on adult human subjects were examined microscopically for trichinæ. In twenty-seven cases, or 5.3 per cent., trichinæ were present.

2. All of the subjects died of other diseases than trichinosis. The infection with trichinæ must, in every case, have occurred a considerable time previously.

3. The infections were of various degrees of severity, being sometimes very extensive, and sometimes so slight that only one or two worms were detected.

4. The birth-places of the subjects included the most important countries of North America and Europe. The number of cases was not large enough to allow accurate conclusions to be formed as to the influence of nationality upon the frequency of the disease. The fact that a large proportion of cases occurred in subjects who were born and had lived in the United States is important.

5. An unusually high percentage of cases occurred among subjects who had been insane.

6. Examination of sections from the above cases for eosinophilic cells failed to show such cells about or near the encapsulated trichinæ.

7. Mast-cells do not collect in or about the capsules, in cases of old trichinosis.

8. Plasma-cells occasionally appear in or about the capsules.

9. New-formed elastic fibres sometimes appear about the capsules.

10. As described by Leuckart and Langerhans, the capsules may be invaded by new cells, the worms disintegrate, and thus the capsule become filled with fibrous and adipose tissue.

Conclusions.

It seems evident that many cases of old trichinosis escape detection at autopsies. A large part of the statistics quoted at the beginning of this paper probably are based upon naked-eye diagnoses by which only very severe forms of the disease would be recognized in a routine examination. Leuckart,¹¹ Virchow,²⁵ Pagenstecher,²⁰ and others remarked thirty years ago that trichinosis would be found at autopsies quite commonly if the search for it were thorough. The writer has no intention of claiming that his results represent the actual frequency of this disease among men in the United States. The exact figures could only be ascertained by examinations made on a much larger scale. Similarly, it would be unsafe to argue from these results as to its frequency in the United States as compared with other countries. But it is important to call attention to it once more from the side of pathological anatomy, to the fact that its lesions may vary from being of a very slight to a very severe extent, and finally to its occurrence among native Americans as well as among those of foreign birth.

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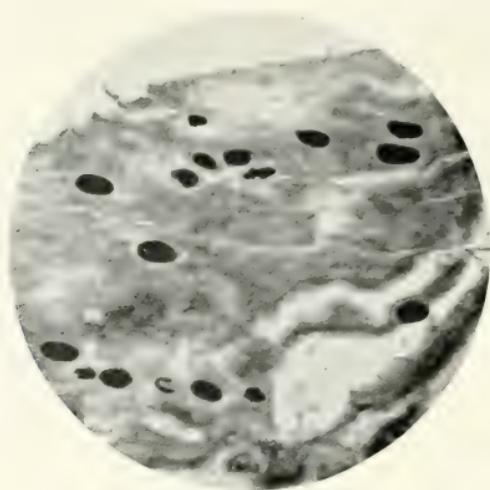


FIG. 1.

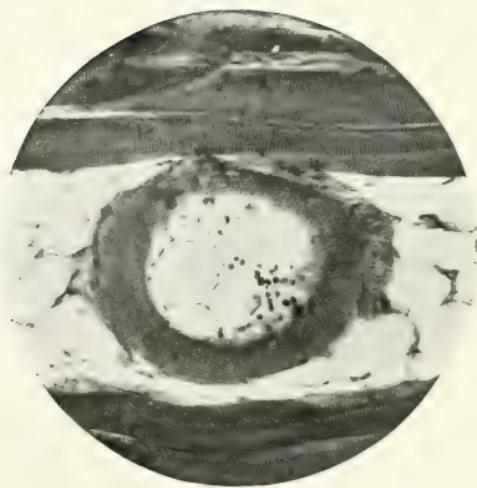


FIG. 2.

WILLIAMS.

TRICHINOSIS.

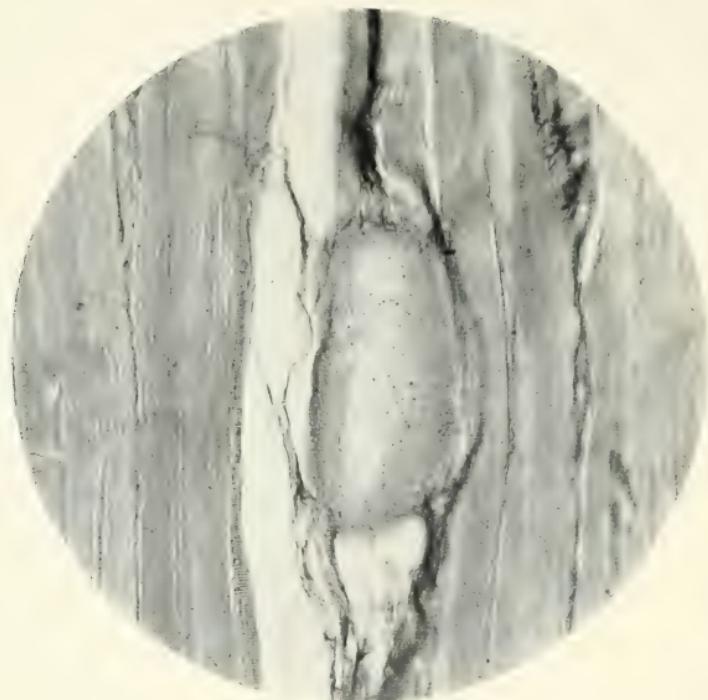


FIG. 3.



FIG. 4.

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EXPLANATION OF PLATES

PLATE V.

Fig. 1. Low power photograph of a section from the diaphragm of Case VII., showing the calcified capsules deeply stained with hematoxylin.

Fig. 2. Section of a capsule which has become filled with newly-formed adipose tissue. (Photomicrograph.)

PLATE VI.

Figs. 3 and 4. Sections showing newly-formed elastic fibres about the capsules, Weigert's stain, highly magnified. (Photomicrograph.)

